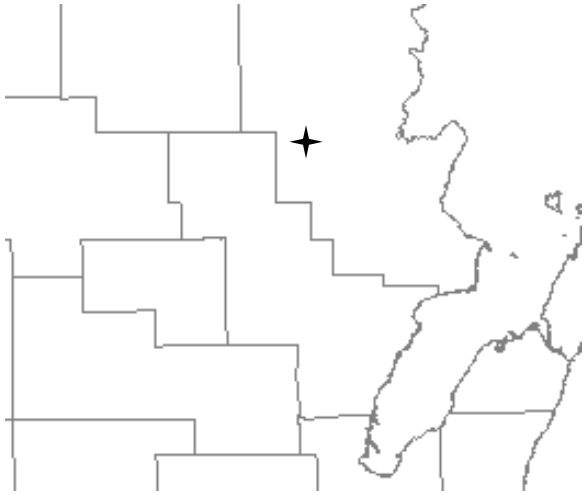
# HIGH FALLS FLOWAGE

Marinette County

2018 Fish Management Report

Christopher C. Long

Fisheries Biologist



Wisconsin Department of Natural Resources
101 N. Ogden Rd.
Suite A
Peshtigo, Wisconsin 54157

2019

# High Falls Flowage; Marinette County, Wisconsin
# 2018 Fish Management Report

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Christopher C. Long, Fisheries Biologist, Date

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Michael C. Donofrio, Fisheries Supervisor, Date

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David E. Boyarski, Eastern District Supervisor, Date

SUMMARY

Lake and location:
High Falls Reservoir, Marinette County, T32N R18E Sec 1.

Physical / chemical attributes (Carson et al. 1977):
**Surface acres:** 1,498
**Maximum depth (ft):** 54
**Average depth (ft):** 12
**Shoreline length (mi):** 22.3
**Lake type:** Impoundment on the Peshtigo River
**Basic water chemistry:** hard water having a neutral, light brown water of high transparency.
**Littoral substrate:** 50% sand, 40% muck, 5% gravel, and 5% rock
**Aquatic vegetation:** Dense submergent vegetation is found in many areas of the reservoir.
**Aquatic invasive species:** Eurasian water milfoil, a non-native invasive plant, is dominant in many shallow-water areas. The presence of Rusty crayfish has also been documented.
**Other features:** High Falls Reservoir was created through the construction of a hydropower facility on the Peshtigo River. A majority of the shoreline is upland hardwoods and conifers owned by the State of Wisconsin and forming part of the Peshtigo River State Forest.

Purpose of survey:
Determine the status of the fishery.

Surveys:
Early spring walleye and muskellunge (5/1/2018 – 5/11/2018)
Spring walleye and muskellunge – SE 1 (5/16/2018 – 5/17/2018)
Late spring bass and panfish – SE 2 (6/5/18 – 6/6/2018)
Fall juvenile walleye (10/16/2018)

Fishery:

The High Falls fishery is comprised of panfish species (bluegill, yellow perch, black crappie, pumpkinseed, and rock bass) and gamefish species (northern pike, walleye, largemouth bass, smallmouth bass, and muskellunge). Other species present include yellow bullhead, black bullhead, white sucker, golden shiner, and common carp.

# EXECUTIVE SUMMARY

- High Falls Flowage is the largest of six impoundments on the Peshtigo River at 1,498 acres. The State of Wisconsin owns a significant portion of the shoreline and operates 8 public access sites around the lake. High Falls has become a popular destination for anglers and boaters because of its natural, scenic beauty and relatively undeveloped shoreline that stretches over 22 miles.
- Overall, 4,602 fish representing 14 species were collected during the 2018 sampling season (Table 4). The five most abundant species collected by number were yellow perch (30%), bluegill (28%), walleye (13%), rock bass (9%), and black crappie (5%).
- A total of 1,372 yellow perch was collected and ranged in length from 3.6 to 9.9 inches and averaged 5.9 inches from the combined electrofishing and fyke netting samples. Four percent of all the perch measured were 8.0 inches or larger. A subsample of 81 perch was aged using otoliths and ranged from 2 to 8 years old. Yellow perch are reaching quality size (8.0 inches) between ages 5 and 6.
- During the survey, 1,276 bluegill were collected. Bluegill ranged in length from 2.5 to 8.3 inches and averaged 5.6 inches from all samples. Overall, 45% of the bluegill measured were 6.0 in or greater. A subsample of 51 bluegill was aged using otoliths and ranged from 2 to 10 years old. Bluegill are reaching a harvestable size (6.0 inches) between ages 4 and 5.
- Six hundred seventeen walleye were collected and accounted for 13% of the total fish collected. Walleye ranged in length from 4.8 to 29.6 inches and averaged 12.3 inches. Twelve percent of the walleye collected during the survey were within protected slot (20.0 to 23.9 inches). A subsample of 182 walleye was aged and ranged from 0 to 17 years old. Walleye are reaching legal size (15 inches) by age 5. Age-5 walleye accounted for 20% of the walleye aged.
- A total of 227 crappie were collected, mostly during the spring fyke netting. Crappie ranged in length from 4.0 to 11.8 inches and averaged 7.1 inches. A subsample of 46 crappie was aged using otoliths and ranged from 2 to 16 years old. A strong year class of 6-year old crappie averaged 8.0 in.
- Northern pike accounted for only 3% of the fish collected in 2018. A total of 147 was collected and ranged in length from 10.9 to 29.1 inches and averaged 19.3 inches. A subsample of 119 northern pike were aged using anal fin rays and ranged from 2 to 10 years old. Pike growth was average compared to northern pike populations in northern Wisconsin.
- A total of 90 smallmouth bass was collected and accounted for 2% of our total sample. Smallmouth ranged in length from 5.7 to 20.2 inches and averaged 14.6 inches. Thirty-three percent of smallmouth bass collected during the survey were over the 14-inch minimum length limit. A subsample of 72 smallmouth bass was aged and ranged from 2 to 14 years old. Smallmouth bass growth was average compared to smallmouth bass populations in northern Wisconsin.
- Eighty-one largemouth bass were collected during the 2018 fisheries surveys and accounted for 2% of the fish collected. Largemouth bass ranged in length from 8.8 to 20.0 inches and averaged 15.1 inches. Seventy-five percent of largemouth bass collected during the survey were over the 14-inch minimum length limit. A subsample of 58 largemouth bass was aged and ranged from 3 to 16 years old. Largemouth bass growth was average until age 8 and below average at older ages compared to largemouth bass populations in northern Wisconsin.
- Sixteen muskellunge were collected during the 2018 survey. Muskies ranged in length from 10.4 to 46.5 inches. A subsample of 11 muskellunge were aged using anal fin rays and ranged from 3

to 11 years old (Figure 19). Musky growth was average compared to musky populations in northern Wisconsin.

- Alternate year stockings of large fingerling walleye (Lake Michigan strain) should continue at the rate of 10 fish/acre but regular, routine monitoring should also continue. Additionally, an effort to access the riverine portion of High Falls (below Caldron Falls dam) should be pursued for spring electrofishing during the next comprehensive fisheries survey. Spring electrofishing upstream in the river may help produce a meaningful population estimate in the future.
- New walleye fishing regulations were implemented in 2015 whereby a 15-inch minimum length limit with a 20 to 24-inch protected slot (with 1 fish over allowed) was established. The daily bag limit is 3. Hopefully, the number of walleye within the protected slot (currently 12% of what was collected in 2018) increases before the next comprehensive fisheries survey.
- According to WDNR literature, the High Falls muskellunge fishery is classified as a "Category 1" or simply stated, natural reproduction is sustaining the fishery. However, this is a misclassification and a more likely scenario is that a combination of both natural reproduction and immigration from Caldron Falls are sustaining the fishery. Stocking of LV fin-clipped muskellunge at the rate of ½ fish/ac in alternate years should continue in High Falls Flowage. Future stockings at Caldron Falls Flowage should continue to incorporate fin clips (RV – right ventral) to better monitor the source of the High Falls muskellunge population and determine the level of natural reproduction, stocking success and immigration.
- A new muskellunge fishing regulation was implemented in 2018 whereby the minimum length limit was increased from 40 inches to 50 inches (the daily bag limit remained at 1 fish).
- Fishing regulations for black bass were amended in the northern bass zone in 2014; largemouth bass are no longer protected under the early catch-and-release season. However, the early catch-and-release season still applies to smallmouth bass.
- Future SE 2 (gamefish/panfish) electrofishing may be expanded to include more sites or conducted at different times (mid-May vs. mid-June) to ensure a representative sample of bass is collected. Alternative fishing regulation options should be evaluated for both largemouth and smallmouth bass if CPUE continues to decline. A SE 2 survey should be completed prior to the next comprehensive fisheries survey to assess bass abundance, size structure, age, growth and recruitment.
- A creel survey should be conducted on High Falls Flowage before or during the next comprehensive fisheries survey. Information such as what species anglers fished for, catch, harvest, fish lengths and hours of fishing effort are all collected. This data is used to make projections of total catch, harvest, fishing effort and guide the development of fishing regulation changes, if necessary.
- The current fishing regulations for all species at High Falls are adequate to provide quality fishing opportunities for anglers and no changes are recommended at this time (Table 8). Besides modest panfishing opportunities, the largemouth and smallmouth bass fisheries proved to be good. Fishing for northern pike will also be good as more quality-sized fish are available. Musky and walleye fishing should improve over time since regular stocking quotas are established for both species.
- The next comprehensive fisheries survey (spring fyke netting, spring SE 1 electrofishing, summer SE 2 electrofishing, and fall electrofishing) of High Falls Flowage is scheduled for 2024 and will focus on the age, growth, abundance, and recruitment of the dominant gamefish.

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# INTRODUCTION

High Falls Flowage is the largest of six impoundments on the Peshtigo River at 1,498 acres. The State of Wisconsin owns a significant portion of the shoreline as the result of land purchased from Wisconsin Public Service that formed the Peshtigo River State Forest. The State also owns and operates 8 public access sites around the lake. High Falls has become a popular destination for anglers and boaters because of its natural, scenic beauty and relatively undeveloped shoreline that stretches over 22 miles. A county park and resorts are available for visitors.

High Falls Flowage is in the Ceded Territory (22,400 square miles of northern Wisconsin that was ceded to the United States by the Lake Superior Chippewa Tribes in 1837 and 1842) and therefore eligible for tribal, off-reservation spearing harvest. From 1991 to 1997, a total of 47 walleye have been harvested during the spearing season. No walleye have been harvested by spearing in High Falls since 1997.

Previous fisheries surveys have documented walleye natural reproduction. However, it is thought inconsistent recruitment was the result of unfavorable environmental conditions during spawning season (Hasz 2006). Walleye were stocked annually between 2001 and 2010 (Table 1). Between 2007 and 2008, a major shift in walleye stocking strategy was adopted whereby large fingerlings (7 to 9 in) were stocked instead of fry. In 2013, the Wisconsin Legislature appropriated funds to WDNR to begin the Wisconsin Walleye Initiative (WWI). This program has increased the production and distribution of large fingerling walleye throughout the State, including High Falls. As a result of the WWI, WDNR began stocking large fingerling walleye into High Falls the rate of 10/ac in 2013 (Table 1). The increase in size at stocking and stocking rate (fish/acre) has improved the walleye population, leading to more fish available for harvest and hopefully increased natural reproduction.

The last fisheries survey of High Falls Reservoir was conducted in 2010 (Long, 2011). The survey indicated healthy populations of panfish (yellow perch, black crappie, and bluegill), black bass (largemouth and smallmouth), northern pike, and walleye. Compared to previous surveys (2000 and 2005) the 2010 survey results showed improved walleye recruitment, an increase in the number of larger northern pike, and good abundance of both largemouth and smallmouth bass (Long, 2011).

The goal of the 2018 comprehensive fisheries survey (spring fyke netting, spring SE 1 electrofishing, summer SE 2 electrofishing, and fall electrofishing) was to assess the status of the

fishery by characterizing gamefish populations based on relative abundance, proportional stock density (PSD), relative stock density (RSD), catch per unit effort (CPUE), mean length at capture (age), and comparisons (where applicable) between the 2010 and 2018 fish surveys.

## METHODS

Data collection:

Standard fyke nets (3-foot hoop, 3/4-bar, 1.5-inch stretch), mini-fyke nets (1/4-inch stretch with turtle exclusion) and a standard WDNR electrofishing boat were used to collect fish throughout the year. Sampling gear, effort, date, and target species for the survey are listed in Table 2. All gamefish fish collected were measured to the nearest 0.1-inch total length (TL). Not all panfish were measured; representative samples were taken to reduce handling mortality from a net or electrofishing run when the sample size was large. A sub-sample of scales or dorsal spines was collected for age and growth analysis from gamefish. Otoliths were taken from bluegill, black crappie and yellow perch for age and growth analysis by staff at the University of Wisconsin – Stevens Point. Aging structures (i.e. scales, spines, otoliths) were collected from 5 fish per half inch group that were not young-of-the-year (YOY). If sex could be determined, structures from 5 fish per sex were collected per half inch group. Ages were assigned to each fish using standard WDNR procedures.

Data analysis:

Catch per unit effort (CPUE) was calculated as catch by gear divided by sampling effort for each species collected. Length frequency distributions were tabulated for dominant gamefish and consisted of electrofishing and fyke net samples. Proportional stock density (PSD) and relative stock density for preferred length fish ($RSD^P$) were calculated for dominant panfish and gamefish (Table 3; Anderson and Neumann 1996). Preferred lengths of various gamefish have a minimum length between 45 and 55% of the world record length for that species (Anderson and Neumann 1996). Stock, quality, and preferred lengths were used as proposed by Gabelhouse (1984). PSD and $RSD^P$ ranges for balanced populations of gamefish and panfish are listed in Table 3. Mean length at capture data was calculated for dominant gamefish and compared to the average of mean length at age for northern Wisconsin.

Population estimates for walleye and northern pike were not calculated during the spring fyke net survey since the number of fish sampled (and subsequent recaptures) was low.

## RESULTS

Overall, 4,602 fish representing 14 species were collected during the 2018 sampling season (Table 4). The five most abundant species collected by number were yellow perch (30%), bluegill (28%), walleye (13%), rock bass (9%), and black crappie (5%).

A total of 1,372 yellow perch was collected which accounted for 30% of our sample (Table 4). About ½ of all perch were measured (672) and ranged in length from 3.6 to 9.9 inches and averaged 5.9 inches from the combined electrofishing and fyke netting samples (Figure 2). Four percent of all the perch measured were 8.0 inches or larger. Perch PSD was 7 and $RSD^P$ was 0; these values are from the June, SE 2 electrofishing sample. Overall, 1,216 yellow perch were collected during the spring fyke netting (CPUE = 9.2/NN) and 156 during the SE 2 electrofishing survey (CPUE = 78.0/mi) (Tables 5 & 6). A subsample of 81 perch was aged using otoliths and ranged from 2 to 8 years old. Yellow perch are reaching quality size (8.0 inches) between ages 5 and 6. Growth was average at all ages compared to the mean length at age of yellow perch in northern Wisconsin (Figure 3).

During the survey, 1,276 bluegill were collected (Table 4). SE 2 electrofishing yielded a CPUE of 218.0/mi and 6.4/NN were captured during spring fyke netting (Tables 5 & 6). Bluegill ranged in length from 2.5 to 8.3 inches and averaged 5.6 inches from the combined electrofishing and fyke netting samples (Figure 4). Overall, 45% of the bluegill measured were 6.0 in or greater. Bluegill PSD was 28 and $RSD^P$ was 0; these values are from the June, SE 2 electrofishing sample. While PSD was within the desirable range for a balanced population, $RSD^P$ was not (Table 3). A subsample of 51 bluegill was aged using otoliths and ranged from 2 to 10 years old. Bluegill are reaching a harvestable size (6.0 inches) between ages 4 and 5. Growth was slightly above average from age 2 to 7 compared to average growth of bluegill in northern Wisconsin (Figure 5).

Six hundred seventeen walleye were collected during the 2018 fisheries survey and accounted for 13% of the total fish collected (Table 4). Spring fyke netting resulted in the collection of 192 walleye with a CPUE of 11.5/NN (Table 5). SE 1 electrofishing yielded a CPUE of 27.8/mi, SE 2 a CPUE of 3.1/mi and fall electrofishing a CPUE of 8.3/mi (Table 6). Only 9 recaptures were recorded during the survey (7 fyke netting; 2 SE 1 electrofishing). Walleye ranged in length from 4.8 to 29.6 inches and averaged 12.3 inches (Figures 6, 7 and 8). Walleye PSD was 92 and $RSD^P$ was 82. Walleye PSD was greater than the desirable range of 30 to 60 (Table 3). Walleye $RSD^P$ is good however, the population is comprised mostly of

larger/older individuals. Twelve percent of the walleye collected during the survey were within protected slot (20.0 to 23.9 inches). A subsample of 182 walleye was aged and ranged from 0 to 17 years old. Walleye are reaching legal size (15 inches) by age 5 (Figure 9). Age-5 walleye averaged 16.0 inches and accounted for 20% of the walleye aged. Compared to the average growth for northern Wisconsin, walleye growth in High Falls Flowage is average at all ages (Figure 9). Due to the low number of recaptures during both spring fyke netting and SE 1 electrofishing, a population estimate was not calculated.

Rock bass made up 9% of the fish collected (Table 4). Electrofishing (SEII) produced a CPUE of 14.5/mi and a fyke net CPUE of 2.8/NN (Tables 5 & 6). Rock bass ranged in length from 2.8 to 11.0 inches and averaged 7.6 inches. Scales were not collected for age and growth analysis of rock bass; however, the length frequency suggests that reproduction and recruitment is stable.

Black crappie comprised 5% of the fish collected (Table 4). A total of 227 crappie were collected, mostly during the spring fyke netting. Black crappie were collected fyke netting at a rate of 1.1/NN and via SE 2 electrofishing at a rate of 39.0/mi (Tables 5 & 6). Crappie ranged in length from 4.0 to 11.8 inches and averaged 7.1 inches (Figure 10). Black crappie PSD 55 was and $RSD^P$ was 1. A subsample of 46 crappie was aged using otoliths and ranged from 2 to 16 years old. A strong year class of 6-year old crappie averaged 8.0 inches. One 10-inch crappie was aged at 16 years old (Figure 11). The growth of black crappie was below average at all ages older than 2 years compared to other lakes in northern Wisconsin (Figure 11).

Northern pike accounted for only 3% of the fish collected in 2018 (Table 4). A total of 147 was collected and ranged in length from 10.9 to 29.1 inches and averaged 19.3 inches (Figure 12). Northern pike electrofishing CPUE in was 0.8/mi (SE 1) and 0.5/mi (SE 2); fyke netting CPUE was 1.1/NN (Tables 5 & 6). Pike PSD was 30 and $RSD^P$ was 2 (from spring fyke netting). The northern pike population is healthy in terms of abundance and size structure since numerous fish between 18 and 21 inches were collected (Figure 12). A subsample of 119 northern pike were aged using anal fin rays and ranged from 2 to 10 years old (Figure 13). Pike growth was average compared to the average growth for northern pike in northern Wisconsin. Due to the low number of recaptures (7) during spring fyke netting, a population estimate was not calculated.

A total of 90 smallmouth bass was collected and accounted for 2% of our total sample (Table 4). SE 2 electrofishing yielded a CPUE of 3.4/mi and fyke netting a CPUE of 0.4/NN

(Tables 5 & 6). Smallmouth ranged in length from 5.7 to 20.2 inches and averaged 14.6 inches (Figure 14). Smallmouth bass PSD was 61 and $RSD^P$ was 42 (from the SE 2 electrofishing sample). PSD was in the desirable range and $RSD^P$ was slightly above the desirable range for a balanced population (Table 3). Thirty-three percent of smallmouth bass collected during the survey were over the 14-inch minimum length limit (Figure 14). A subsample of 72 smallmouth bass was aged and ranged from 2 to 14 years old. Smallmouth bass growth was average compared to the average growth for bass in northern Wisconsin (Figure 15). Smallmouth are reaching legal size (14 inches) between ages 6 and 7. Successful reproduction and recruitment of smallmouth bass were evident judging from the wide size range and age classes collected.

Eighty-one largemouth bass were collected during the 2018 fisheries surveys and accounted for 2% of the fish collected (Table 4). SE 2 electrofishing yielded a CPUE of 4.5/mi and fyke netting a CPUE of 0.3/NN (Tables 5 & 6). Bass ranged in length from 8.8 to 20.0 inches and averaged 15.1 inches (Figure 16). Largemouth bass PSD was 76 and $RSD^P$ was 51 (from the SE 2 electrofishing sample). Both PSD and $RSD^P$ were above the desirable range for a balanced population (Table 3). Seventy-five percent of largemouth bass collected during the survey were over the 14-inch minimum length limit (Figure 16). A subsample of 58 largemouth bass was aged and ranged from 3 to 16 years old. Largemouth bass growth was average until age 8 and below average at older ages compared to the average growth for bass in northern Wisconsin (Figure 17). Largemouth are reaching legal size (14 inches) between ages 6 and 7. Successful reproduction and recruitment of largemouth bass were evident judging from the wide size range and age classes collected.

Sixteen muskellunge were collected during the 2018 survey (Table 4). Muskies ranged in length from 10.4 to 46.5 inches (Figure 18). No muskellunge were captured during SE 1 electrofishing and for the other surveys, musky CPUE was 0.3/mi (SE 2), 0.5/mi (fall); fyke netting CPUE was 0.1/NN (Tables 5 & 6). A subsample of 11 muskellunge were aged using anal fin rays and ranged from 3 to 11 years old (Figure 19). Musky growth was similar to the average growth in northern Wisconsin.

Additionally, white sucker, pumpkinseed, brook trout, and bullheads (black and yellow) accounted for roughly 8.5% of the remaining fish collected during the 2018 survey (Table 4).

## DISCUSSION

The fishery in High Falls Flowage is healthy and diverse. Good populations of panfish (bluegill, yellow perch, black crappie, pumpkinseed, and rock bass) and gamefish (northern pike, walleye, largemouth bass, smallmouth bass, and muskellunge) are present.

Limited comparisons were possible between the two previous comprehensive fisheries surveys of High Falls in 2005 and 2010 because sampling protocol changed between surveys. However, sampling protocols remained unchanged between the 2010 and 2018 fisheries surveys and as a result, our ability to detect changes in fish populations improved since sampling was more consistent between those survey years.

Bluegill numbers declined slightly between 2010 and 2018 (236/mile and 9.2/NN in 2010 to 218/mile and 6.4/NN in 2018). However bluegill size structure improved from 2010 to 2018 meaning there are now a high percentage of bluegill larger than 6 inches present (PSD increased from 19 in 2010 to 28 in 2018; Figure 4). Bluegill $RSD^P$ was 0 in both surveys meaning few bluegill larger than 8 inches were collected. On the other hand, yellow perch electrofishing and fyke netting CPUE's both increased between 2010 and 2018 and size structure improved slightly (Tables 5, 6 and 8; Figure 2). Currently the yellow perch population is dominated by a strong year class of 6-year old fish averaging 7.2 inches. Anglers should anticipate encountering more, larger perch in the coming years.

Black crappie abundance has waned between 2010 and 2018 (fyke netting CPUE decreased from 2.0/NN in 2010 to 1.1/NN in 2018; Table 6). The apparent decline in abundance should not be alarming since crappie are cyclic spawners; successful reproduction and recruitment can be highly variable or unpredictable from year to year. A couple of good year classes of crappie were produced since the last survey that should recruit to the fishery over the next few years. Most abundant were age-3 crappie averaged 5.5 inches and age-6 crappie averaged 8.0 inches. The oldest fish in our sample was a 16-year-old, 10-inch crappie. Crappie fishing will remain marginal for the next several years and should improve as younger fish recruit to the fishery. However, due to slow growth, it is unlikely that High Falls will produce many large, trophy sized crappie.

Walleye numbers increased between 2010 and 2018. Fyke netting CPUE improved from 1.0 walleye/NN in 2010 to 1.5 walleye/NN in 2018 (Table 5) and spring electrofishing (SE 1) CPUE also increased from 3.9/mile in 2010 to 27.8/mile in 2018 (Table 6). The increase in spring fyke netting and SE 1 electrofishing CPUE can mostly be attributed to the large number of

age-1 walleye collected. These age-1 walleye were stocked in the fall of 2017 (Table 1; Figures 6 and 7).

Large fingerling walleye stocked in the fall of 2017 averaged 7.8 inches however, numerous walleye less than 6.0 inches were collected during the spring SE 1 electrofishing. Age and growth analysis confirmed that most walleye < 7.5 inches collected in the spring were age-0 and the result of natural reproduction that occurred in 2017 (even though no age-0 walleye were collected during the fall electrofishing survey in 2017) (Figure 8A). The 2018 survey confirmed both good walleye natural reproduction and survival of stocked fish in 2017.

Fall walleye electrofishing CPUE increased between 2010 and 2018 from 5.9/mile to 8.3/mile for fish 2 years old and younger (Table 6). Ten age-0 and 27 age-1 walleye were collected during the fall walleye electrofishing survey in 2018 and confirmed that natural reproduction is occurred in 2018 (Figure 8). Fall walleye CPUE's for age-0 and age-1 walleye have been highly variable in High Falls over the last 5 years (Figure 8). In stocked years, sampling must occur before stocking in order to determine if age-0 walleye captured are naturally reproduced. This often means water temperatures exceed the recommended sampling temperature range (50º to 60º F) which may lead to lower catch rates than what would be expected if sampling occurred later in the fall thus maybe contributing to the observed variability in fall CPUE's (Figure 8). In 2010, large fingerling walleye were fin clipped before stocking. Fifty-nine walleye were collected in the fall of 2010 of which, 44 were YOY. Twenty-nine of the YOY collected were fin-clipped. Overall, these results confirmed that walleye natural reproduction is occurring, but stocked fish also make up a substantial portion of the walleye fishery.

Stocking of large fingerling walleye was completed in 2013, 2015, and 2017 at the rate of 10/acre (Table 1). These stocked fish likely influence the mean length at age of age-0 and age-1 walleye in some years (Figure 8A). Growth for age-0, age-1 and age-2 walleye has fluctuated between 2010 and 2018 (Table 9; Figure 8A). In years following stocking (i.e. 2014, 2016, and 2018), and if natural reproduction is detected, the mean length of age-1 walleye was lower than age-1 walleye in other years (Figure 8A). For example, in 2014 a good year class of age-0 walleye was collected and the mean length of age-1 walleye was 8.1 inches whereas in 2016, a year when no stocking occurred, the mean length of age-1 walleye was 9.8 inches (Table 9; Figure 8A). On the other hand, the 2017-year class (age-1 in 2018) averaged 9.4 inches even though good natural reproduction also occurred in 2017 (Table 9; Figure 8A). Regardless, the

2018 survey demonstrated that both stocking and natural reproduction are contributing to the walleye fishery in High Falls.

Two floy-tagged walleyes were collected in 2018 that were originally tagged in 2010. One walleye measured 19.1 inches (age 7) in 2010 and was 25.4 inches long in 2018 (age 15); this fish grew 6.3 inches in 8 years. The other tagged walleye was 11.2 inches (age 2) when tagged in 2010 and measured 24.4 inches long in 2018 (age 10); this fish grew 13.2 inches in 8 years. While this information is only an example of 2 individual fish, it appears to demonstrate the disparity of growth between individual fish. It will be necessary to evaluate age and growth of adult walleye during future surveys as the younger, stocked year classes mature. This evaluation will be especially important considering both the current protected slot limit (no harvest of walleye between 20 and 24 inches; only 1 allowed over 24 inches) and the current detectable level of natural reproduction. Perhaps once the adult density of walleye increases to a level where a meaningful population estimate can be generated, stocking can be better evaluated and modified, if necessary.

Spring electrofishing 2 (SE 2) is used to assess abundance and size structure of bass populations. SE 2 electrofishing CPUE declined for both smallmouth and largemouth bass between 2010 and 2018 (Table 6). Smallmouth bass CPUE dropped from 19.8/mile in 2010 to 3.4/mile in 2018 and largemouth bass CPUE from 12.3/mile in 2010 to 4.5/mile in 2018 (Table 6). Despite what appears to be a decline in both largemouth and smallmouth bass abundance, size structure of both species remained good. Largemouth bass PSD increased from 70 to 76 and $RSD^P$ increased from 37 to 51 between 2010 and 2018. Similarly, smallmouth bass PSD decreased from 79 to 61 and $RSD^P$ decreased from 50 to 42 between 2010 and 2018. Even though smallmouth bass PSD and $RSD^P$ declined, both are close to the desirable range for balanced populations (Table 3). It is likely that the timing and water temperature of the SE 2 sampling (June 2018 – 68.5 º water temperature versus May 2010 – 63.7º water temperature) affected our results and assessment of the bass populations in High Falls. Numerous (4) bass tournaments were held on High Falls in 2018 and the results were consistent with previous tournaments suggesting that largemouth and smallmouth bass abundance is stable.

Muskellunge stockings have occurred on a limited basis in High Falls since 1997 (Table 1). Over 11,000 surplus small fingerlings were stocked in 2013 but an annual quota for large fingerling musky (10-12 inches) was established in 2017 based on support for the 50-inch minimum length limit that went into effect in 2018. The alternate year stocking quota for High

Falls was set at ½ fish per acre or about 750 fish. The recommendation to stock at a lower rate was because the few muskies already present in High Falls had exhibited good growth. Therefore, to maintain good growth, and ultimately size structure, it was decided to stock at a lower rate.

Muskies initially became established in High Falls likely because of fish coming through/over the Caldron Falls dam. Large fingerling muskies stocked in High Falls receive a left ventral (LV) fin clip whereas large fingerling muskies stocked in Caldron Falls receive a right ventral (RV) fin clip. The different fin clips, or the absence of a fin clip, will identify where the fish were stocked and the level of natural reproduction in future surveys. In 2017, 417 large fingerlings (10.8-inch average; LV fin clip) and 2,555 surplus small fingerlings (6.3-inch average; NO fin clip) muskies were stocked in High Falls (Table 1). During the SE 2 and fall electrofishing surveys in 2018, 7 total muskies were collected (Table 6). Six of those fish were less than 13.5 inches and 3 had a LV fin clip (11.6, 12.8, and 13.5 inches), indicating they were from the 2017 stocking. The other 3 muskies had no fin clip (10.4, 10.4 and 11.3 inches) and were either from the surplus small fingerling stocking or the result of natural reproduction.

All muskellunge collected during the spring fyke netting survey in 2010 were PIT tagged. A musky recapture spring fyke netting survey was also completed in 2011. Only 1 musky was recaptured in 2011 from the 2010 survey. In 2018, 2 PIT-tagged muskies were recaptured from the 2010 survey. One musky measured 41.4 inches (age 8) in 2010 and was 42.9 inches long in 2018 (age 16); this fish grew 1.5 inches in 8 years. The other tagged musky was 37.7 inches (age 7) when tagged in 2010 and measured 40.6 inches long in 2018 (age 15); this fish grew 2.9 inches in 8 years. It is surprising that these two fish grew so little in 8 years especially since musky growth was average compared to the mean length at age for other lakes in northern Wisconsin (Figure 19).

Musky fyke netting CPUE remained the same at 0.1 fish/NN (Table 5). The musky fishery in High Falls should improve over time since stocking is now taking place and the fishery is no longer dependent on immigration of musky from Caldron Falls.

## CONCLUSIONS & RECOMMENDATIONS

The 2018 fisheries survey of High Falls Reservoir indicated good numbers of gamefish (northern pike and walleye) and panfish species such as bluegill, yellow perch, and black crappie. Largemouth and smallmouth bass abundance seems lower than in previous surveys.

The timing of sampling and the amount of sampling effort may need to be adjusted in future surveys to ensure representative samples are collected.

Walleye were stocked in High Falls annually from 2001 to 2012. Walleye fry were stocked at various densities from 2001 to 2007 however, the stocking of large fingerling walleye began in 2008 to create more consistent year class strength and improve walleye fishing opportunities. The survival of large fingerling walleye stocked in 2017 was good but survival of the walleye stocked in 2013 and 2015 is less clear. In the future, adult walleye density should increase which may lead to improved natural reproduction before the next comprehensive fisheries survey in 2024. Therefore, alternate year stockings of large fingerling walleye (Lake Michigan strain) should continue at the rate of 10 fish/acre but annual fall electrofishing should also continue to evaluate their survival and contribution to the fishery since High Falls is a sentinel or study lake for the Walleye Initiative. Additionally, an effort to access the riverine portion of High Falls in the spring (below Caldron Falls dam) should be pursued as part of the next comprehensive fisheries survey. When the ice begins to go out on High Falls, most adult walleyes are upstream spawning but all boat landings are locked up with ice. Therefore, spring electrofishing upstream in the river may help produce a meaningful population estimate in the future.

New walleye fishing regulations were implemented in 2015. The previous regulation consisted of a 15-inch minimum length limit and the daily bag limit fluctuated based on tribal harvest declarations. In 2015, a 15-inch minimum length limit with a 20 to 24-inch protected slot (with 1 fish over allowed) was established. The daily bag limit is 3 regardless of tribal harvest declarations. This regulation will protect sexually mature adults between 20 and 24 inches thereby giving them an increased opportunity to spawn. This is significant since natural reproduction contributes to the walleye fishery.

High Falls is known for having large muskies, but a very low density (adult fish/ac). The muskellunge fishery is classified as a “Category 1” or simply stated, natural reproduction is sustaining the fishery. This is a misclassification and the more likely scenario is that a combination of both natural reproduction and immigration from Caldron Falls are sustaining the fishery. However, both sources are inadequate to support a density indicative of a quality/trophy muskellunge fishery. Therefore, stocking of LV fin-clipped muskellunge at the rate of ½ fish/ac in alternate years should continue in High Falls Flowage. Future stockings at Caldron Falls Flowage should continue to incorporate fin clips (RV – right ventral) to better monitor the source

of the High Falls muskellunge population and determine the level of natural reproduction, stocking success and immigration.

In addition to stocking, a new muskellunge fishing regulation was implemented in 2018 whereby the minimum length limit was increased from 40 inches to 50 inches (the daily bag limit remained at 1 fish). There are 2 reasons this regulation was proposed. Primarily, High Falls Flowage is listed as a "Class A1" musky fishery. Class A1 musky fisheries are defined as "waters best known as trophy waters for their ability to consistently produce a number of large muskellunge, but overall abundance of muskellunge may be relatively low. Angling action can be inconsistent in these waters, but the fish that are caught have a larger average size. At certain times when conditions are right, however, these waters can also produce good action" (Simonson, 2012). Secondly, the forage base, which is comprised mostly of panfish, is abundant. As a result, increased predation by muskellunge might improve panfish growth and size structure.

Fishing regulations for black bass were amended in the northern bass zone in 2014; largemouth bass are no longer protected under the early catch-and-release season from the first Saturday in May to the second Saturday in June (Table 7). However, the early catch-and-release season still applies to smallmouth bass which cannot be harvested until the second Saturday in June. Future SE 2 (gamefish/panfish) electrofishing may be expanded to include more sites or conducted at different times (mid-May vs. mid-June) to ensure a representative sample of bass is collected. Alternative fishing regulation options will be evaluated for both largemouth and smallmouth bass if CPUE in future SE 2 surveys declines further. A SE 2 survey should be completed prior to the next comprehensive fisheries survey to assess bass abundance, size structure, age, growth and recruitment. Age and growth data for largemouth and smallmouth bass could also be collected from tournament anglers to supplement data from the SE2 surveys. This would aid in the potential development of a fishing regulation change, if necessary.

A creel survey should be conducted on High Falls Flowage before or during the next comprehensive fisheries survey. A creel survey is an assessment tool used for sampling the fishing activities of anglers on a body of water and make projections of fish harvest. Creel survey clerks work on randomly-selected days and shifts, 40 hours/week during the fishing season except for November. These surveys are conducted during daylight hours and shift times change from month to month as day length changes. Creel survey clerks count anglers on the lake at predetermined times and interview anglers who have completed their fishing trip.

Information such as what species anglers fished for, catch, harvest, fish lengths and hours of fishing effort are all collected. This data is used to make projections of total catch, harvest, fishing effort and guide the development of fishing regulation changes, if necessary.

The current fishing regulations for all species at High Falls are adequate to provide quality fishing opportunities for anglers and no changes are recommended at this time (Table 8). Besides modest panfishing opportunities, the largemouth and smallmouth bass fisheries proved to be good. Anglers targeting one or both species should have success. Average growth, good size structure, and consistent recruitment will sustain both bass populations. Fishing for northern pike will also be good as more quality-sized fish are available. Musky and walleye fishing should improve over time since regular stocking quotas are established for both species.

The next comprehensive fisheries survey (spring fyke netting, spring SE 1 electrofishing, summer SE 2 electrofishing, and fall electrofishing) of High Falls Flowage is scheduled for 2024 and will focus on the age, growth, abundance, and recruitment of the dominant gamefish. Access is adequate with several boat ramps around the reservoir and shore-fishing opportunities are good since most of the shoreline is within the Peshtigo River State Forest. Control of Eurasian watermilfoil, a non-native species of aquatic vegetation is recommended. Many shallow areas of the lake are dominated by milfoil. Boaters are reminded to remove all vegetation from their boat and trailer before leaving to limit the spread of this and other invasive species. A map of High Falls Flowage can be found at the following internet address; (http://dnr.wi.gov/lakes/maps/DNR/0540600a.pdf).

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# APPENDIX I – TABLES

Table 1. Fish stocking history for High Falls Flowage; Marinette County, WI.

| Year | Species | Strain Stock | Age Class | Source Type | Number Stocked | Avg Length |
|---|---|---|---|---|---|---|
| 1997 | MUSKELLUNGE | UNSPECIFIED | YEARLING | PRIVATE | 285 | |
| 1997 | MUSKELLUNGE | UNSPECIFIED | LARGE FINGERLING | PRIVATE | 115 | |
| 1998 | MUSKELLUNGE | UNSPECIFIED | YEARLING | PRIVATE | 100 | 13.0 |
| 2013 | MUSKELLUNGE | UNSPECIFIED | YEARLING | PRIVATE | 200 | 10.0 |
| 2013 | MUSKELLUNGE | UPPER WISCONSIN RIVER | SMALL FINGERLING | DNR | 11,503 | 4.0 |
| 2017 | MUSKELLUNGE | UPPER WISCONSIN RIVER | LARGE FINGERLING | DNR | 471 | 10.8 |
| 2017 | MUSKELLUNGE | UPPER WISCONSIN RIVER | SMALL FINGERLING | DNR | 2,555 | 6.3 |
| | | | | | | |
| 1992 | WALLEYE | UNSPECIFIED | FINGERLING | PRIVATE | 5,000 | 3.0 |
| 1998 | WALLEYE | UNSPECIFIED | LARGE FINGERLING | PRIVATE | 5,000 | 8.0 |
| 2001 | WALLEYE | UNSPECIFIED | FRY | DNR | 350,000 | |
| 2002 | WALLEYE | UNSPECIFIED | FRY | DNR | 750,000 | |
| 2003 | WALLEYE | UNSPECIFIED | FRY | DNR | 800,000 | |
| 2004 | WALLEYE | UNSPECIFIED | FRY | DNR | 1,000,000 | |
| 2005 | WALLEYE | LAKE MICHIGAN | FRY | DNR | 1,000,000 | |
| 2006 | WALLEYE | LAKE MICHIGAN | FRY | DNR | 60,000 | |
| 2007 | WALLEYE | LAKE MICHIGAN | FRY | DNR | 750,000 | |
| 2008 | WALLEYE | UNSPECIFIED | LARGE FINGERLING | PRIVATE | 2,000 | 7.0 |
| 2009 | WALLEYE | LAKE MICHIGAN | LARGE FINGERLING | DNR | 2,498 | 7.4 |
| 2009 | WALLEYE | UNSPECIFIED | LARGE FINGERLING | PRIVATE | 2,000 | 7.0 |
| 2009 | WALLEYE | MISSISSIPPI HEADWATERS | SMALL FINGERLING | DNR | 22,032 | 1.7 |
| 2010 | WALLEYE | MISSISSIPPI HEADWATERS | LARGE FINGERLING | DNR | 4,998 | 7.9 |
| 2011 | WALLEYE | UNSPECIFIED | LARGE FINGERLING | PRIVATE | 2,000 | 7.0 |
| 2012 | WALLEYE | LAKE MICHIGAN | LARGE FINGERLING | DNR | 1,347 | 7.4 |
| 2012 | WALLEYE | UNSPECIFIED | LARGE FINGERLING | PRIVATE | 2,000 | 7.0 |
| 2013 | WALLEYE | MISSISSIPPI HEADWATERS | LARGE FINGERLING | DNR | 14,973 | 7.3 |
| 2015 | WALLEYE | LAKE MICHIGAN | LARGE FINGERLING | DNR | 14,678 | 7.6 |
| 2017 | WALLEYE | LAKE MICHIGAN | LARGE FINGERLING | DNR | 14,777 | 7.8 |

Table 2. Sampling gear, date, target species, sampling effort, and location (distance) for 2018 fisheries survey on High Falls Flowage; Marinette County, WI.

| Sampling Gear | Date | Target Species | Sampling Effort miles (mi) or net nights |
|---|---|---|---|
| | | | |
| Fyke net | May 1 to May 11 | All fish | 132 NN |
| | | | |
| Electrofishing (SE 1) | May 16 & May 17 | Walleye & Muskellunge | 10.0 mi |
| Electrofishing (SE 2) | June 5 & June 6 | Gamefish & Panfish | 10.0 mi |
| Electrofishing | October 18 | YOY walleye & muskellunge | 8.0 mi |

Table 3. Proposed length categories for various fish species. Measurements are total lengths for each category in inches. Updated from Anderson and Neumann (1996) and Bister et al. (2000).

| Species | PSD | RSD-P | Stock | Quality | Preferred | Memorable | Trophy |
|---|---|---|---|---|---|---|---|
| Black crappie | | | 5 | 8 | 10 | 12 | 15 |
| Bluegill | 20 - 60 | 5 - 20* | 3 | 6 | 8 | 10 | 12 |
| Brown bullhead | | | 5 | 8 | 11 | 14 | 17 |
| Largemouth bass | 40 - 70 | 10 - 40* | 8 | 12 | 15 | 20 | 25 |
| Muskellunge | | | 20 | 30 | 38 | 42 | 50 |
| Northern pike | 30 - 60 | | 14 | 21 | 28 | 34 | 44 |
| Pumpkinseed | | | 3 | 6 | 8 | 10 | 12 |
| Rock bass | 20 - 60 | | 4 | 7 | 9 | 11 | 13 |
| Walleye | 30 - 60 | | 10 | 15 | 20 | 25 | 30 |
| Yellow perch | | | 5 | 8 | 10 | 12 | 15 |
| Yellow bullhead | | | 4 | 7 | 9 | 11 | 14 |

*Range based on management strategy for balanced populations.

Table 4. Species composition and length range of fishes collected in 2018 on High Falls Flowage; Marinette County, WI.

| SPECIES COMPOSITION OF FISHES COLLECTED BY NUMBER | | | |
|---|---|---|---|
| *Common Name of Fish | Number | Percent | Length Range (inches) |
| Yellow perch | 1,372 | 30% | 3.6 - 9.9 |
| Bluegill | 1,276 | 28% | 2.5 - 8.3 |
| Walleye | 617 | 13% | 4.8 - 29.6 |
| Rock bass | 402 | 9% | 2.8 - 11.0 |
| Black crappie | 227 | 5% | 4.0 - 11.8 |
| Yellow bullhead | 179 | 4% | 5.2 - 13.1 |
| Pumpkinseed | 170 | 4% | 2.6 - 7.9 |
| Northern pike | 147 | 3% | 10.9 - 29.1 |
| Smallmouth bass | 90 | 2% | 5.7 - 20.5 |
| Largemouth bass | 81 | 2% | 8.8 - 20.0 |
| Black bullhead | 18 | 0.4% | 7.3 - 12.2 |
| Muskellunge | 16 | 0.3% | 10.4 - 46.5 |
| White sucker | 6 | 0.1% | 15.1 - 21.5 |
| Brook trout | 1 | < 0.1% | 14.2 |
| | | | |
| TOTAL | 4,602 | | |

* Common names of fishes recognized by the American Fisheries Society.

Table 5. Comparison of spring fyke netting data from High Falls Flowage; Marinette County, WI.

| 2018 Fyke Netting (132*) | | | 2010 Fyke Netting (244*) | | |
|---|---|---|---|---|---|
| Species | Total Catch | Mean Catch per net night | Species | Total Catch | Mean Catch per net night |
| BLACK BULLHEAD | 17 | 0.1 | BLACK BULLHEAD | 1 | < 0.1 |
| BLACK CRAPPIE | 149 | 1.1 | BLACK CRAPPIE | 477 | 2.0 |
| BLUEGILL | 840 | 6.4 | BLUEGILL | 2255 | 9.2 |
| BROOK TROUT | 1 | < 0.1 | | | |
| | | | COMMON CARP | 2 | < 0.1 |
| GOLDEN SHINER | 2 | < 0.1 | GOLDEN SHINER | 6 | < 0.1 |
| LARGEMOUTH BASS | 38 | 0.3 | LARGEMOUTH BASS | 214 | 0.9 |
| MUSKELLUNGE | 9 | 0.1 | MUSKELLUNGE | 25 | 0.1 |
| NORTHERN PIKE | 143 | 1.1 | NORTHERN PIKE | 654 | 2.7 |
| PUMPKINSEED | 136 | 1.0 | PUMPKINSEED | 248 | 1.0 |
| ROCK BASS | 373 | 2.8 | ROCK BASS | 197 | 0.8 |
| SMALLMOUTH BASS | 57 | 0.4 | SMALLMOUTH BASS | 99 | 0.4 |
| WALLEYE | 192 | 1.5 | WALLEYE | 249 | 1.0 |
| WHITE SUCKER | 3 | < 0.1 | WHITE SUCKER | 5 | < 0.1 |
| YELLOW BULLHEAD | 179 | 1.4 | YELLOW BULLHEAD | 145 | 0.6 |
| YELLOW PERCH | 1216 | 9.2 | YELLOW PERCH | 2024 | 8.3 |
| TOTAL | 3,355 | | TOTAL | 6,601 | |

*Sampling effort in net nights for each corresponding year.

Table 6. High Falls Flowage electrofishing summary (2018 and 2010); Marinette County, WI.

| | Spring walleye & muskellunge (SE 1) | | | | Summer gamefish & panfish (SE 2) | | | | Fall YOY walleye & muskellunge | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2018 May** | | 2010 April | | **2018 June** | | 2010 May | | **2018 October** | | 2010 November | |
| | **Total** | **CPUE** | Total | CPUE | **Total** | **CPUE** | Total | CPUE | **Total** | **CPUE** | Total | CPUE |
| Species | **Catch** | **/mile** | Catch | /mile | **Catch** | **/mile** | Catch | /mile | **Catch** | **/mile** | Catch | /mile |
| Bluegill | | | | | **436** | **218.0** | 472 | 236.0 | | | | |
| Yellow perch | | | | | **156** | **78.0** | 29 | 14.5 | | | | |
| Northern pike | | | | | **11** | **1.1** | 15 | 1.9 | | | | |
| Black crappie | | | | | **78** | **39.0** | 130 | 65.0 | | | | |
| Walleye | **339** | **27.8** | 45 | 3.9 | **10** | **3.1** | 33 | 4.1 | **66** | **8.3** | 59 | 5.9 |
| Largemouth bass | | | | | **45** | **4.5** | 98 | 12.3 | | | | |
| Pumpkinseed | | | | | **34** | **17.0** | 10 | 5.0 | | | | |
| Smallmouth bass | | | | | **34** | **3.4** | 158 | 19.8 | | | | |
| Rock bass | | | | | **29** | **14.5** | 27 | 13.5 | | | | |
| Muskellunge | **0** | | 4 | 0.4 | **3** | **0.3** | 3 | 0.4 | **4** | **0.5** | 1 | 0.1 |

Table 7. Fishing regulations for the 2018-2019 fishing season on High Falls Flowage; Marinette County, WI.

| Species | Fishing Season | Daily Limit | Minimum Length |
|---|---|---|---|
| Smallmouth bass | 1st Saturday in May - June 15 | 0 | Catch and release |
| | June 16 - 1st Sunday in March | 5 (in total with LMB) | 14 inches |
| Largemouth bass | 1st Saturday in May - June 15 | 5 in total | 14 inches |
| | June 16 - 1st Sunday in March | 5 (in total with SMB) | 14 inches |
| Northern pike | 1st Saturday in May - 1st Sunday in March | 5 | None |
| Muskellunge | Last Saturday in May - November 30 | 1 | 50 inches |
| Walleye | 1st Saturday in May - 1st Sunday in March | 3 | 15"-20" may be kept; only 1 over 24 inches |
| Panfish (bluegill, pumpkinseed, crappie, and yellow perch | Open all year | 25 in total | None |
| Bullheads | Open all year | None | None |
| Rock bass | Open all year | None | None |
| Trout species | 1st Sunday in May - 1st Saturday in March | 3 in total | 8 inches |

Table 8. Species comparison and length range for 2010 and 2018 fisheries surveys on High Falls Flowage; Marinette County, WI.

| SPECIES COMPOSITION OF FISHES COLLECTED BY NUMBER | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2018 | | | | 2010 | | | |
| *Common Name of Fish | Number | Percent | Length Range (inches) | *Common Name of Fish | Number | Percent | Length Range (inches) |
| Yellow perch | 1,372 | 30% | 3.6 - 9.9 | Bluegill | 2,727 | 35% | 2.4 - 8.7 |
| Bluegill | 1,276 | 28% | 2.5 - 8.3 | Yellow perch | 2,053 | 27% | 4.5 - 8.8 |
| Walleye | 617 | 13% | 4.8 - 29.6 | Northern pike | 669 | 9% | 9.6 - 34.3 |
| Rock bass | 402 | 9% | 2.8 - 11.0 | Black crappie | 607 | 8% | 4.3 - 12.0 |
| Black crappie | 227 | 5% | 4.0 - 11.8 | Walleye | 386 | 5% | 6.5 - 29.9 |
| Yellow bullhead | 179 | 4% | 5.2 - 13.1 | Largemouth bass | 312 | 4% | 3.9 - 20.1 |
| Pumpkinseed | 170 | 4% | 2.6 - 7.9 | Pumpkinseed | 258 | 3% | 3.8 - 7.7 |
| Northern pike | 147 | 3% | 10.9 - 29.1 | Smallmouth bass | 257 | 3% | 6.7 - 20.4 |
| Smallmouth bass | 90 | 2% | 5.7 - 20.5 | Rock bass | 224 | 3% | 3.8 - 10.5 |
| Largemouth bass | 81 | 2% | 8.8 - 20.0 | Yellow bullhead | 147 | 2% | 7.4 - 13.5 |
| Black bullhead | 18 | 0.4% | 7.3 - 12.2 | Muskellunge | 33 | 0.4% | 12.2 - 49.2 |
| Muskellunge | 16 | 0.3% | 10.4 - 46.5 | White sucker | 29 | 0.4% | not measured |
| White sucker | 6 | 0.1% | 15.1 - 21.5 | Golden shiner | 11 | 0.1% | 5.5 - 7.0 |
| Brook trout | 1 | < 0.1% | 14.2 | Common carp | 2 | < 0.1% | not measured |
| | | | | Black bullhead | 1 | < 0.1% | not measured |
| | | | | | | | |
| TOTAL | 4,602 | | | TOTAL | 7,716 | | |
| * Common names of fishes recognized by the American Fisheries Society. | | | | | | | |

Table 9. Mean length at age of walleye collected during fall electrofishing surveys between 2010 and 2018 on High Falls Flowage; Marinette County, WI.

| Survey Year | Survey Begin Date | Survey End Date | Species | Age | Number of Fish | AVG Length IN | Min Length IN | Max Length IN |
|---|---|---|---|---|---|---|---|---|
| 2010 | 1-Nov-10 | 3-Nov-10 | WALLEYE | 0 | 2 | 7.7 | 7.4 | 7.9 |
| | | | | 1 | 14 | 9.5 | 8.2 | 10.9 |
| | | | | 2 | 2 | 11.8 | 11.5 | 12.0 |
| 2014 | 30-Sep-14 | 1-Oct-14 | WALLEYE | 0 | 18 | 7.2 | 6.5 | 8.0 |
| | | | | 1 | 10 | 8.1 | 7.0 | 9.5 |
| | | | | 2 | 2 | 8.7 | 8.1 | 9.2 |
| 2015 | 8-Sep-15 | 8-Sep-15 | WALLEYE | 1 | 8 | 8.8 | 8.5 | 9.3 |
| | | | | 2 | 9 | 9.9 | 9.0 | 10.7 |
| 2016 | 27-Sep-16 | 19-Oct-16 | WALLEYE | 1 | 9 | 9.8 | 8.8 | 10.7 |
| | | | | 2 | 1 | 11.4 | 11.4 | 11.4 |
| 2017 | 19-Sep-17 | 19-Sep-17 | WALLEYE | 2 | 3 | 11.4 | 10.8 | 12.4 |
| 2018 | 16-Oct-18 | 16-Oct-18 | WALLEYE | 0 | 10 | 7.1 | 6.3 | 7.7 |
| | | | | 1 | 27 | 9.4 | 7.9 | 11.1 |

# APPENDIX II – FIGURES

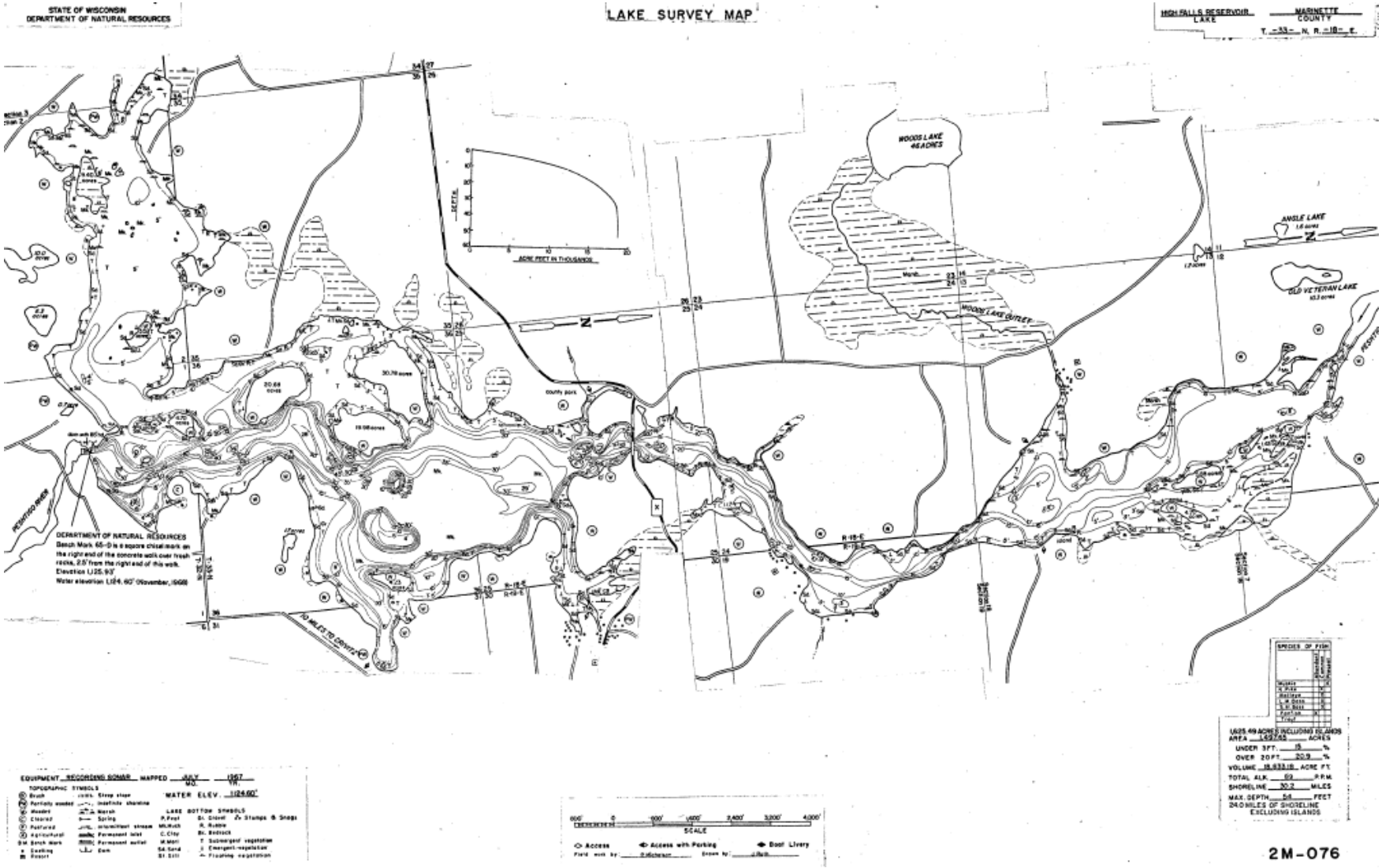


Figure 1. Map of High Falls Flowage.

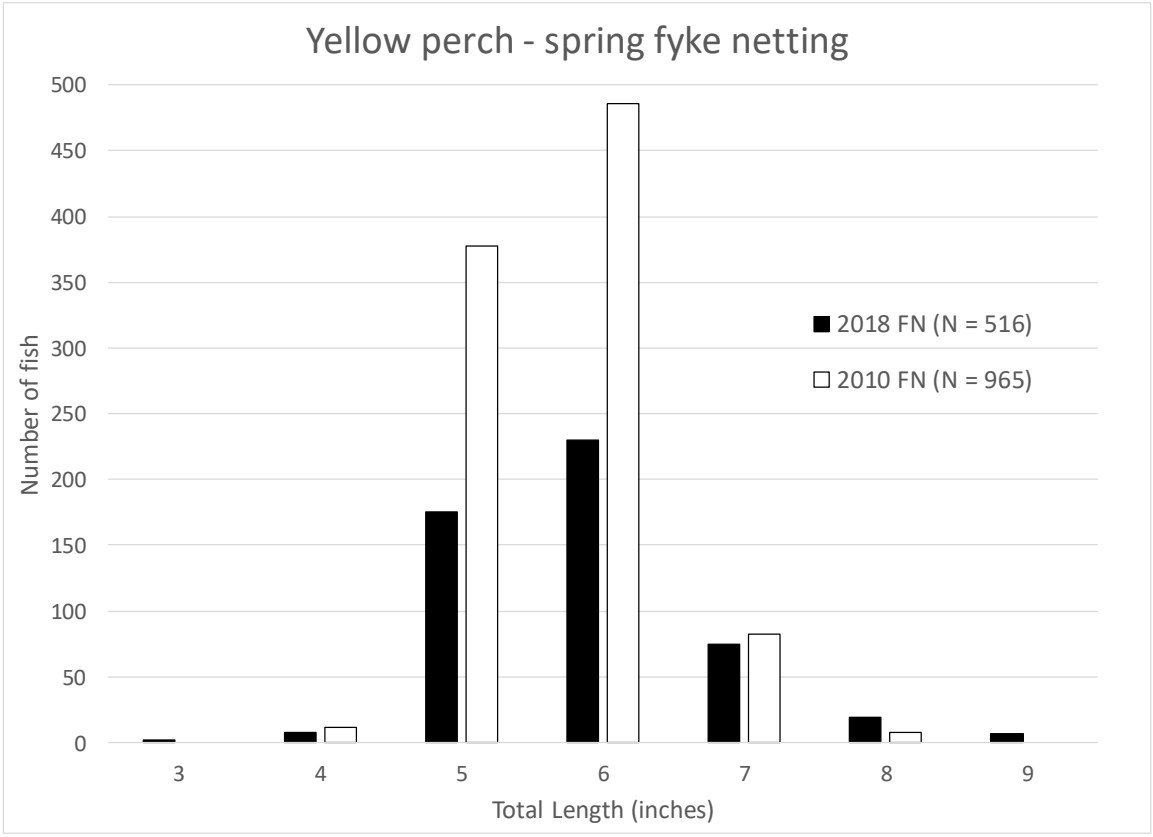

Figure 2. Yellow perch spring fyke netting length frequency from 2010 and 2018 on High Falls Flowage; Marinette County, WI.

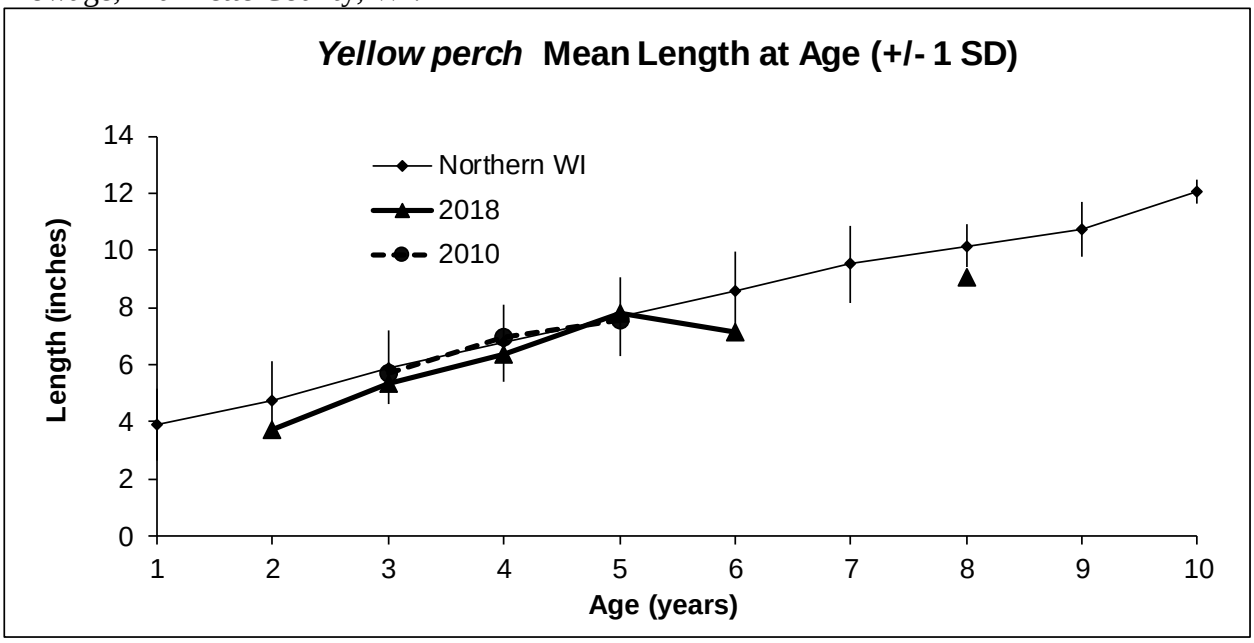

Figure 3. Yellow perch mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.

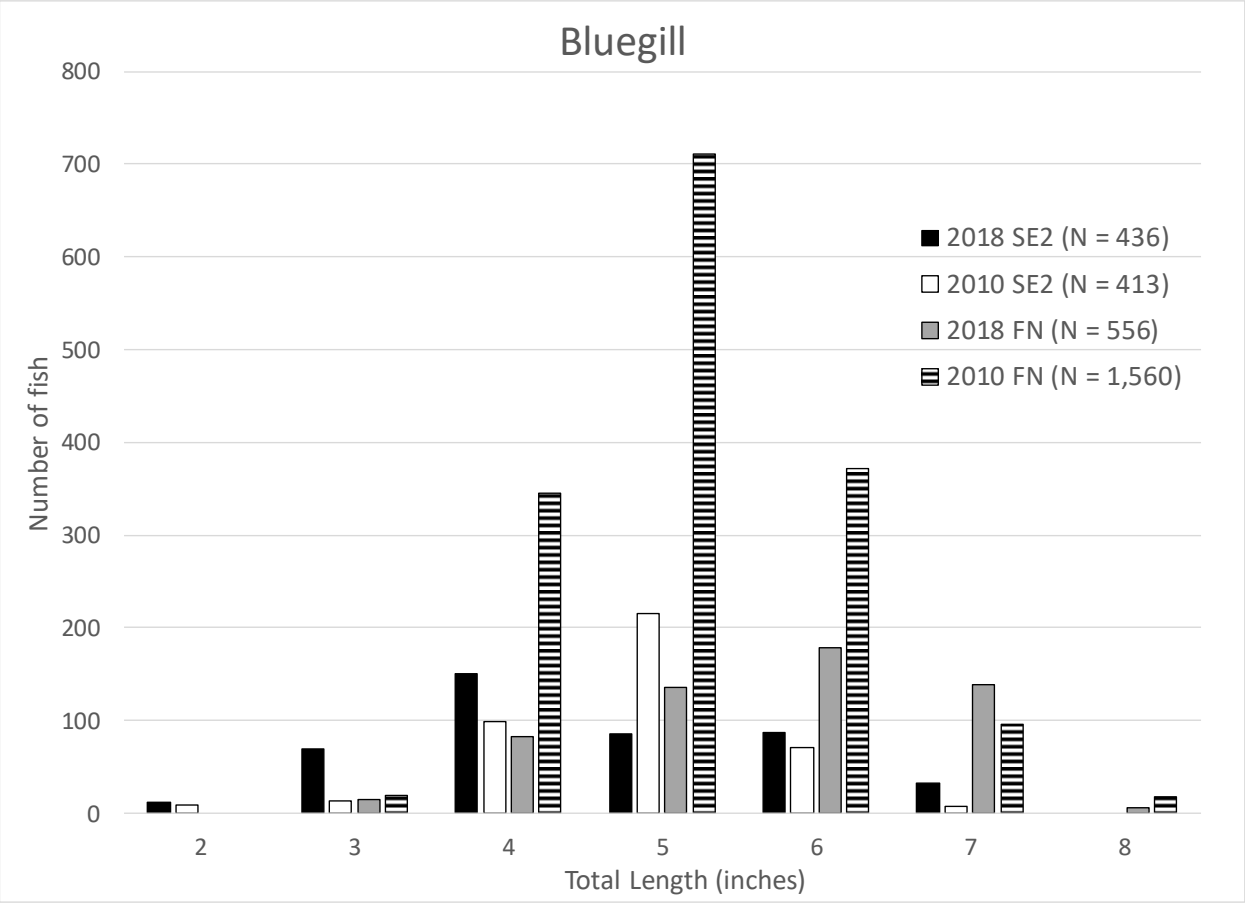


Figure 4. Bluegill length frequency from 2010 and 2018 on High Falls Flowage; Marinette County, WI.

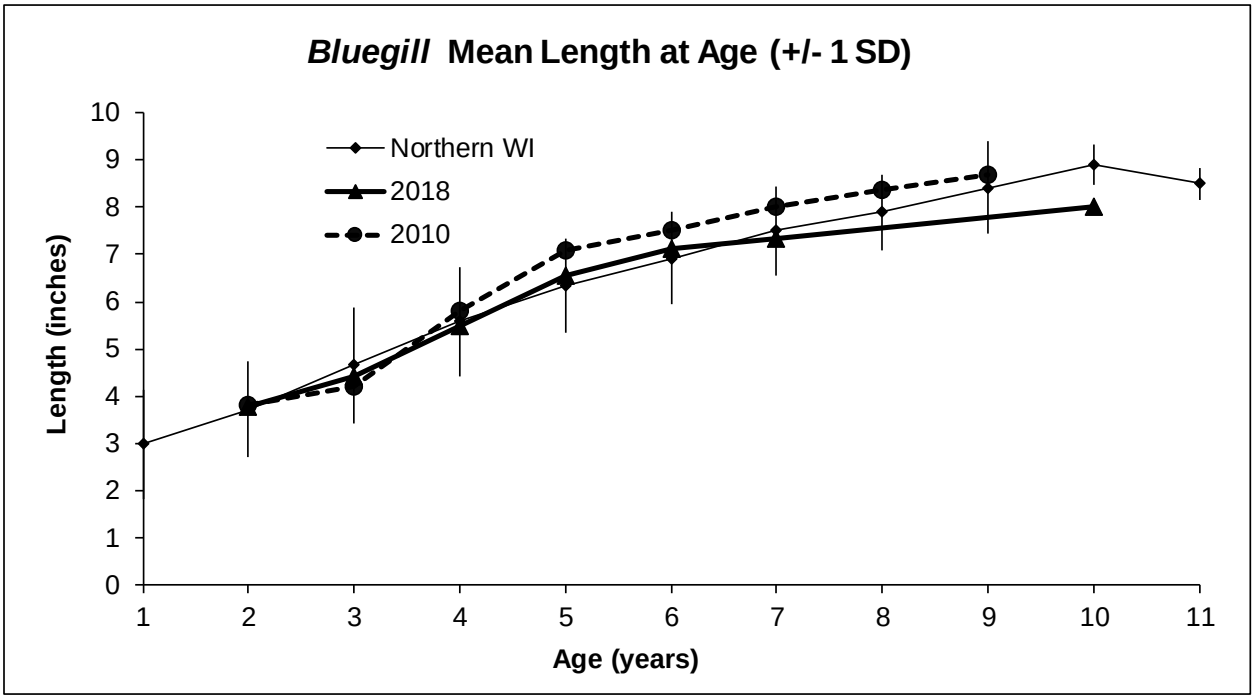


Figure 5. Bluegill mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.

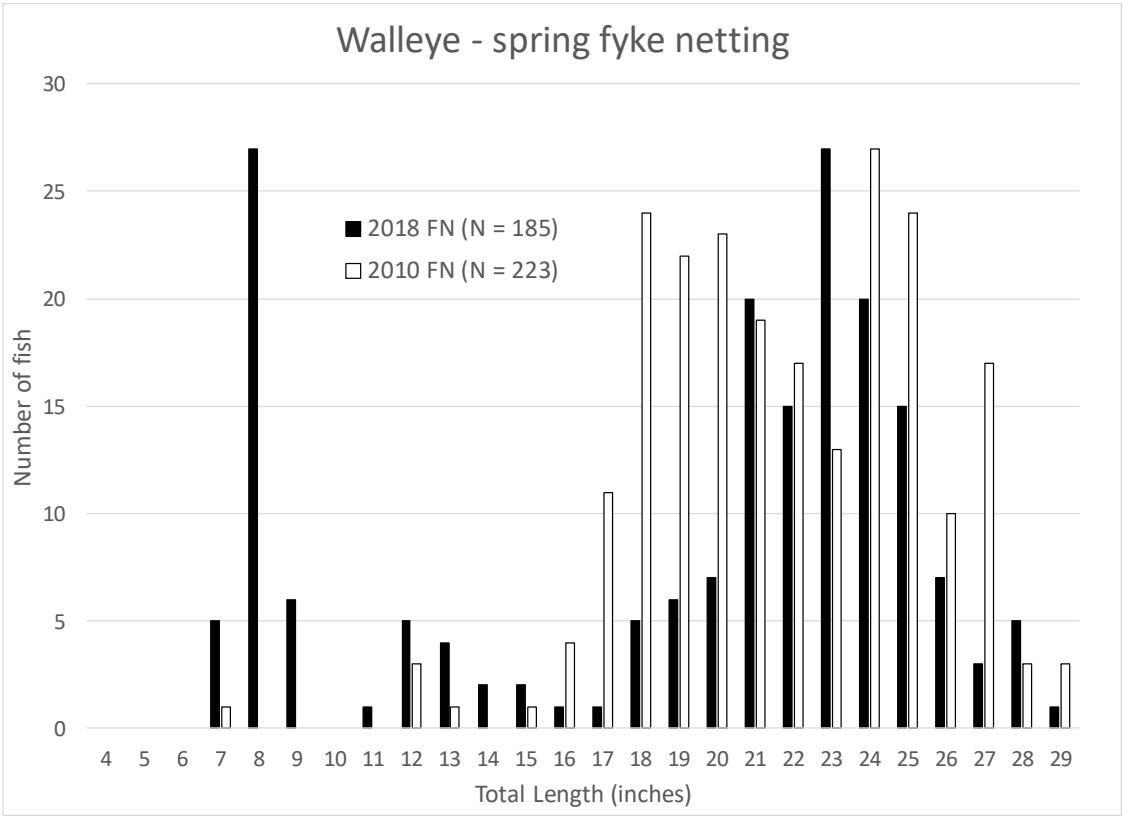


Figure 6. Walleye length frequency from spring fyke netting in 2010 and 2018 on High Falls Flowage; Marinette County, WI.

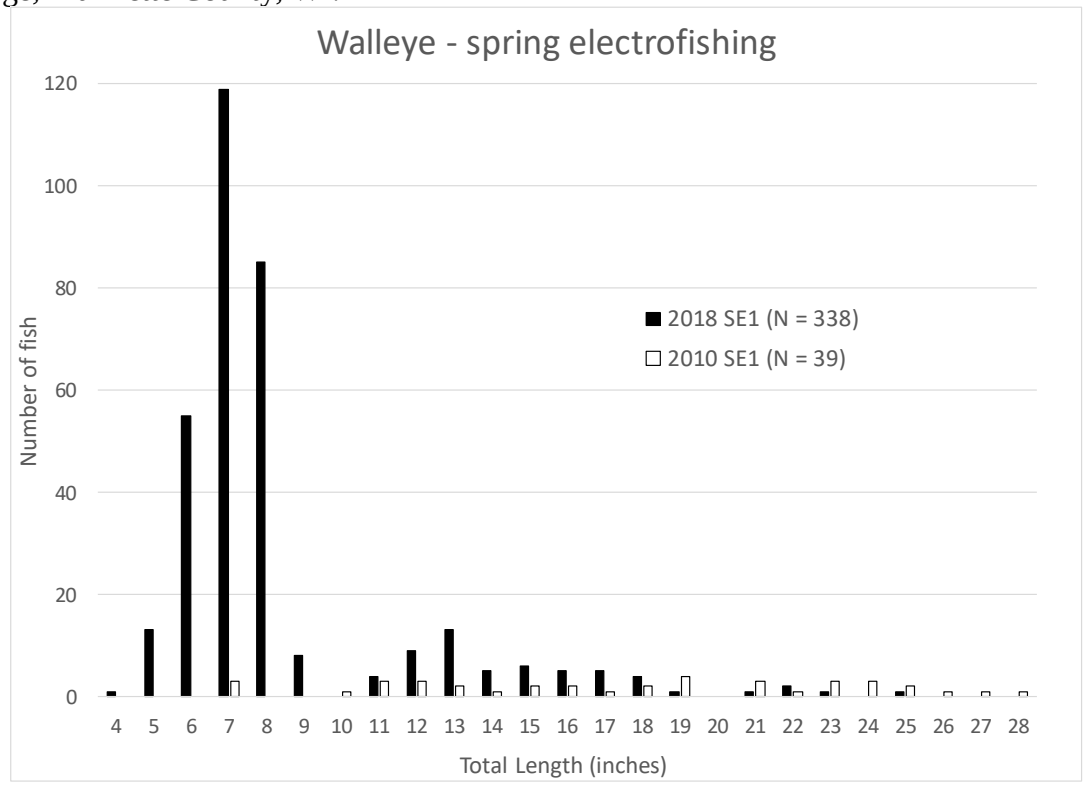


Figure 7. Walleye length frequency from spring electrofishing in 2010 and 2018 on High Falls Flowage; Marinette County, WI.

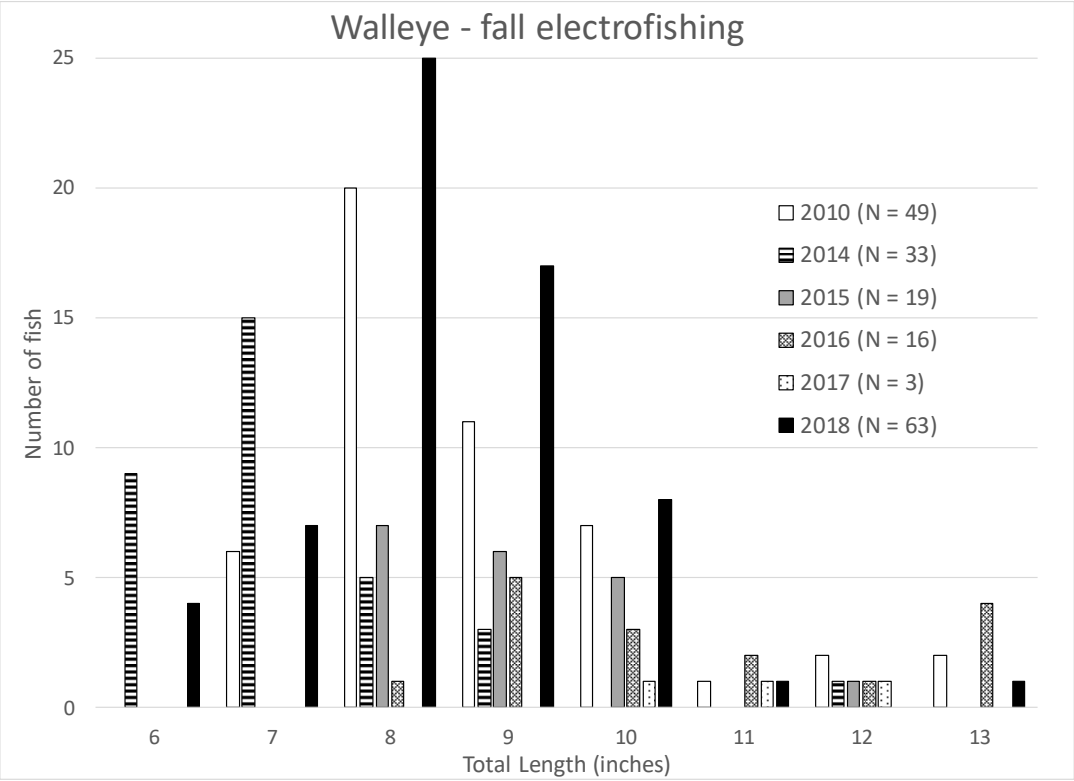


Figure 8. Walleye length frequency from fall electrofishing 2010 to 2018 on High Falls Flowage; Marinette County, WI.

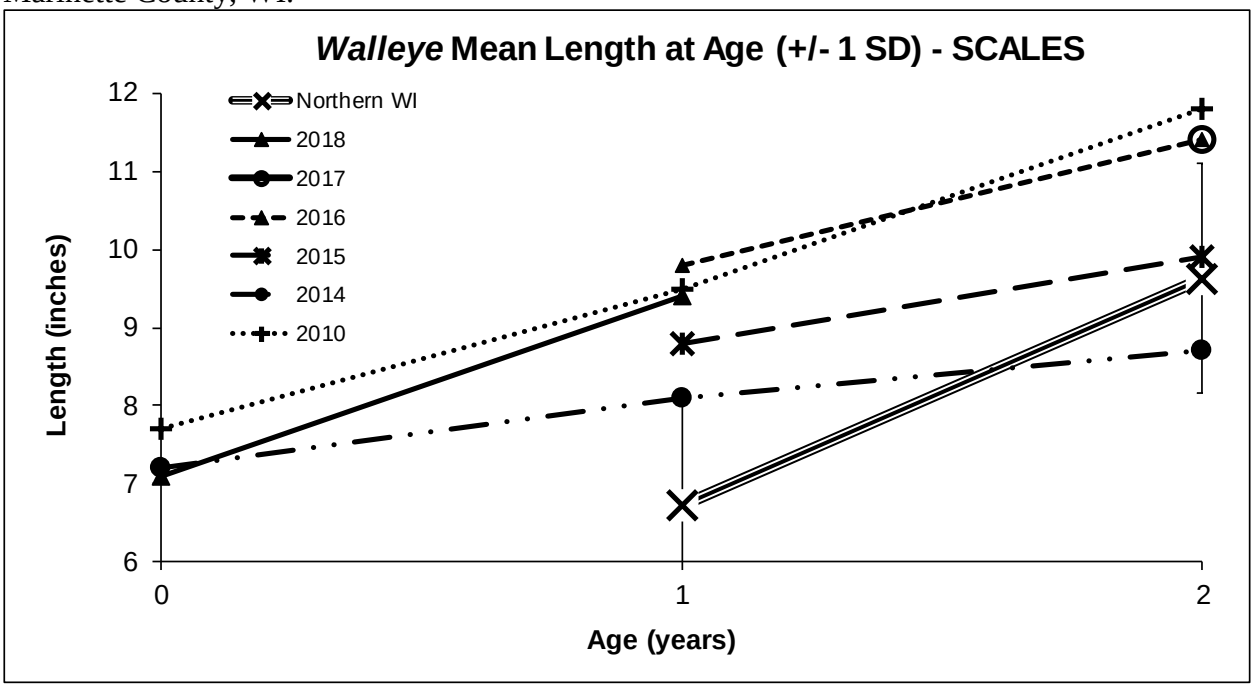


Figure 8A. Mean length at age (+/-1SD) for age-0, age-1 and age-2 walleye in High Falls Flowage; Marinette County, WI.

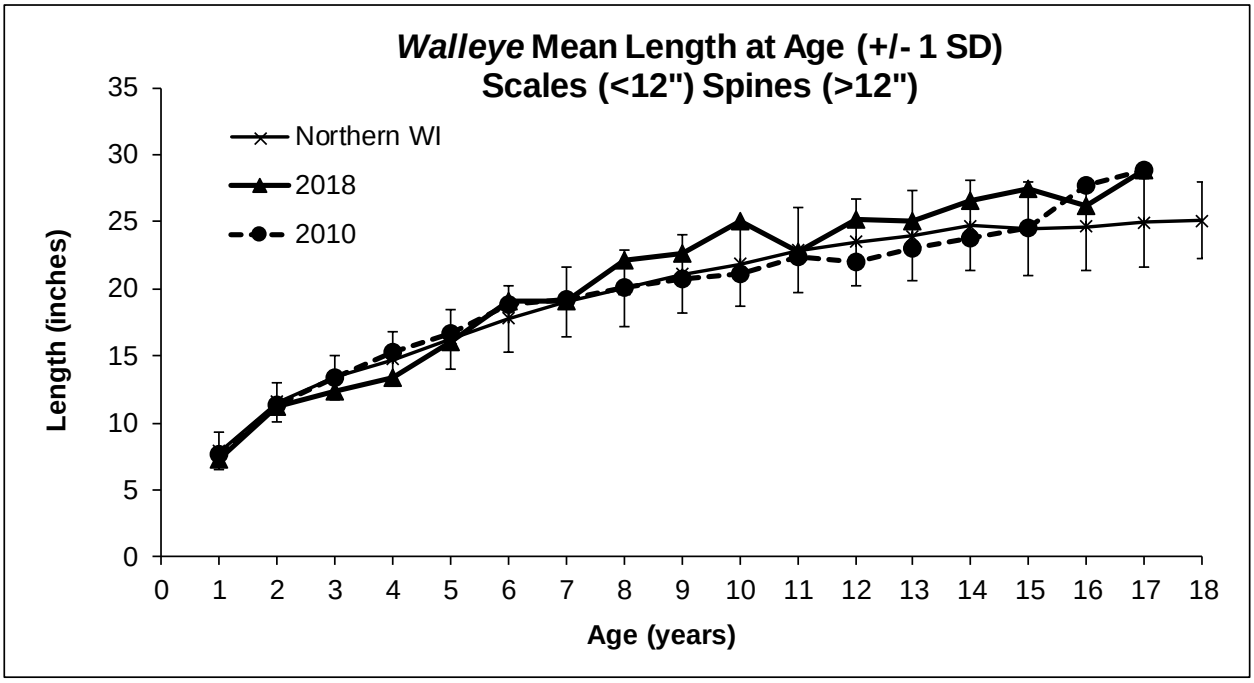

Figure 9. Walleye mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.

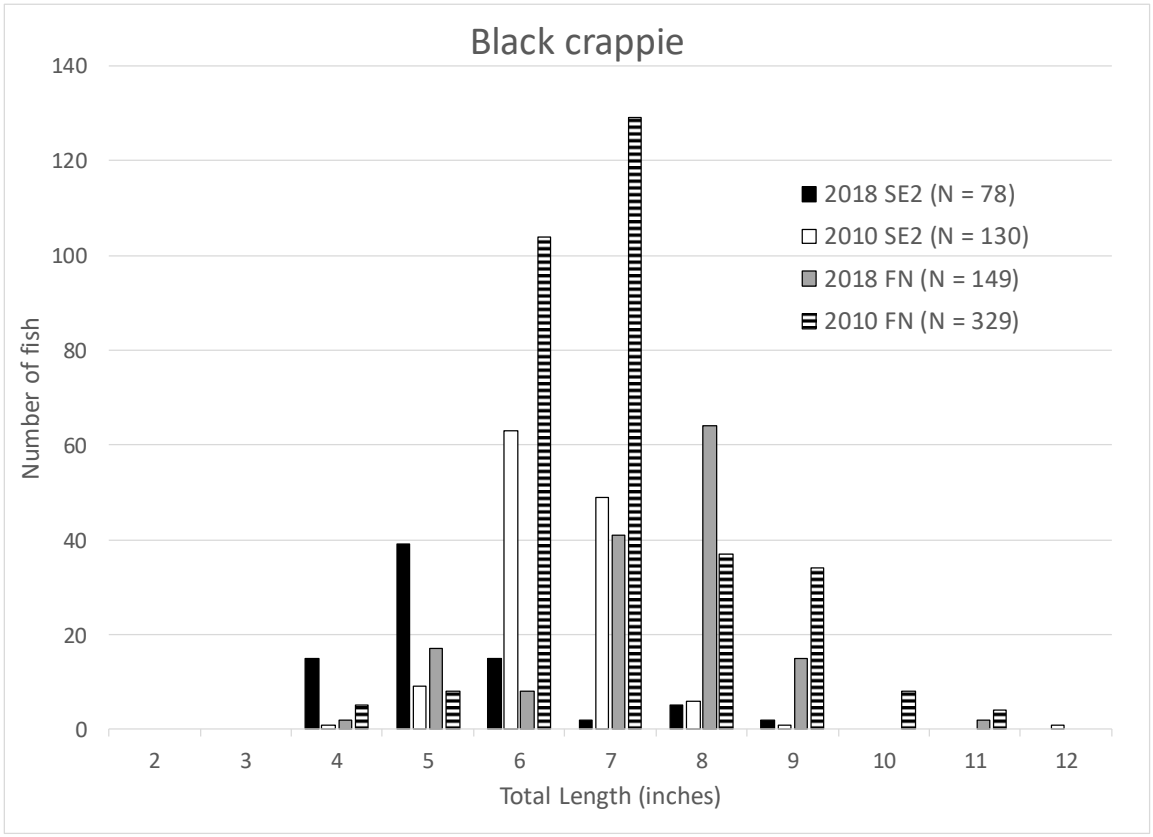

Figure 10. Black crappie length frequency from 2010 and 2018 on High Falls Flowage; Marinette County, WI.

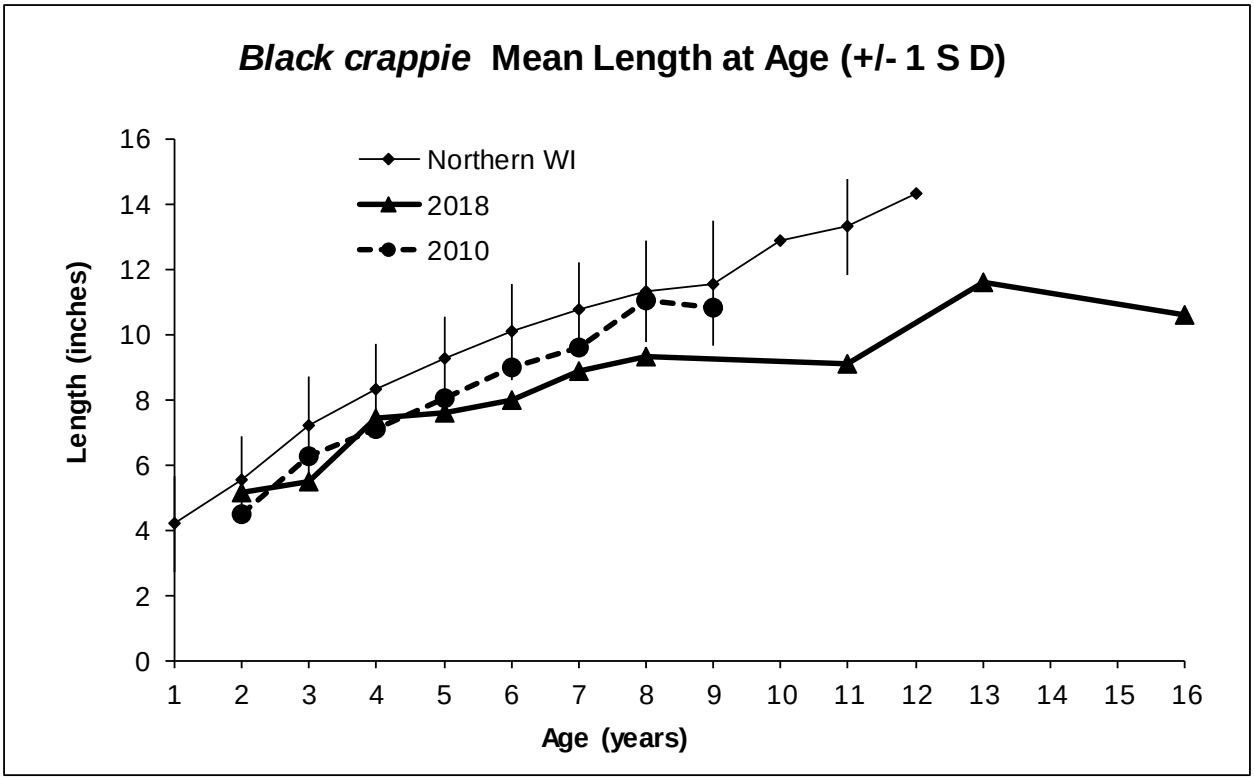

Figure 11. Black crappie mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.

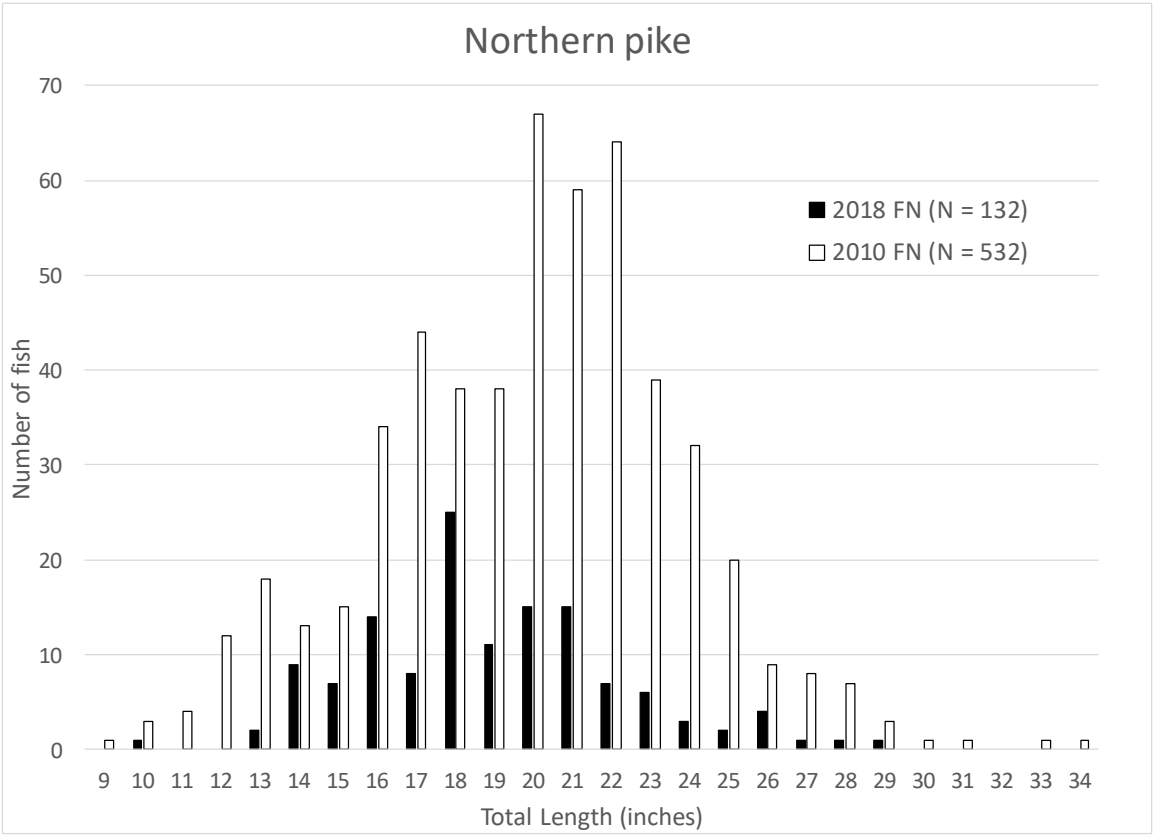

Figure 12. Northern pike length frequency from 2010 and 2018 on High Falls Flowage; Marinette County, WI.

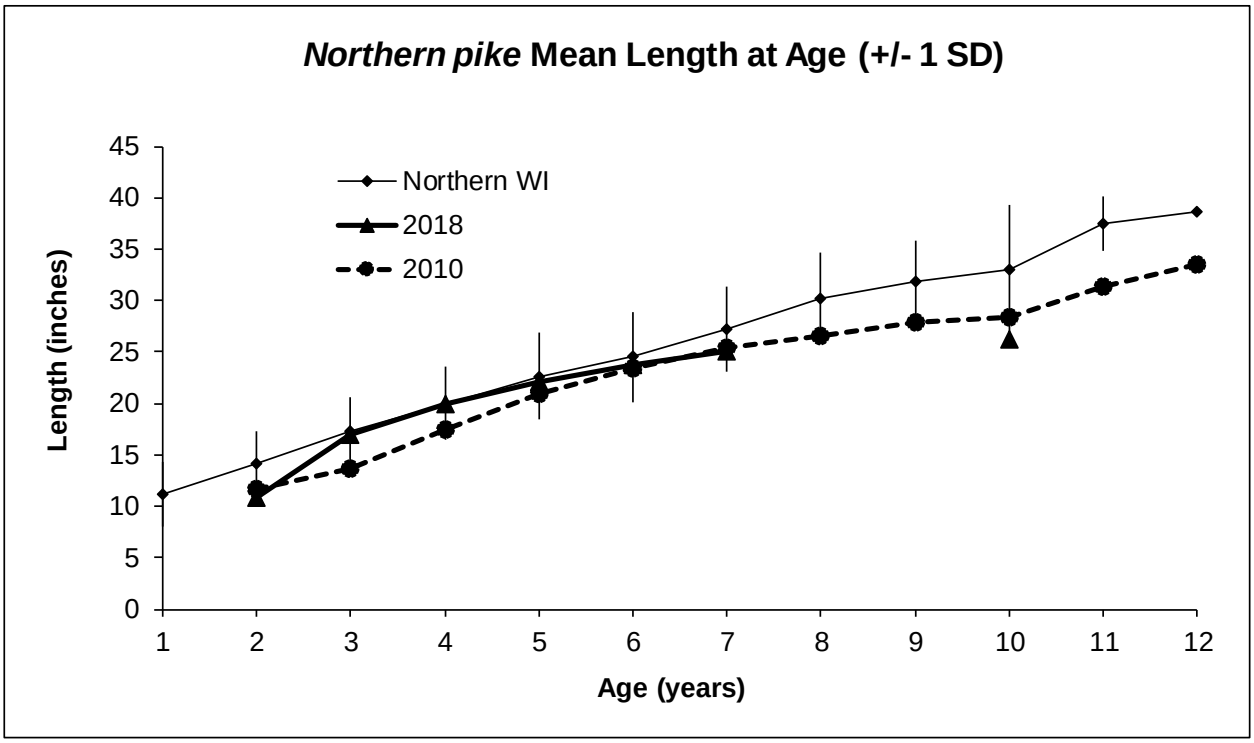

Figure 13. Northern pike mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.

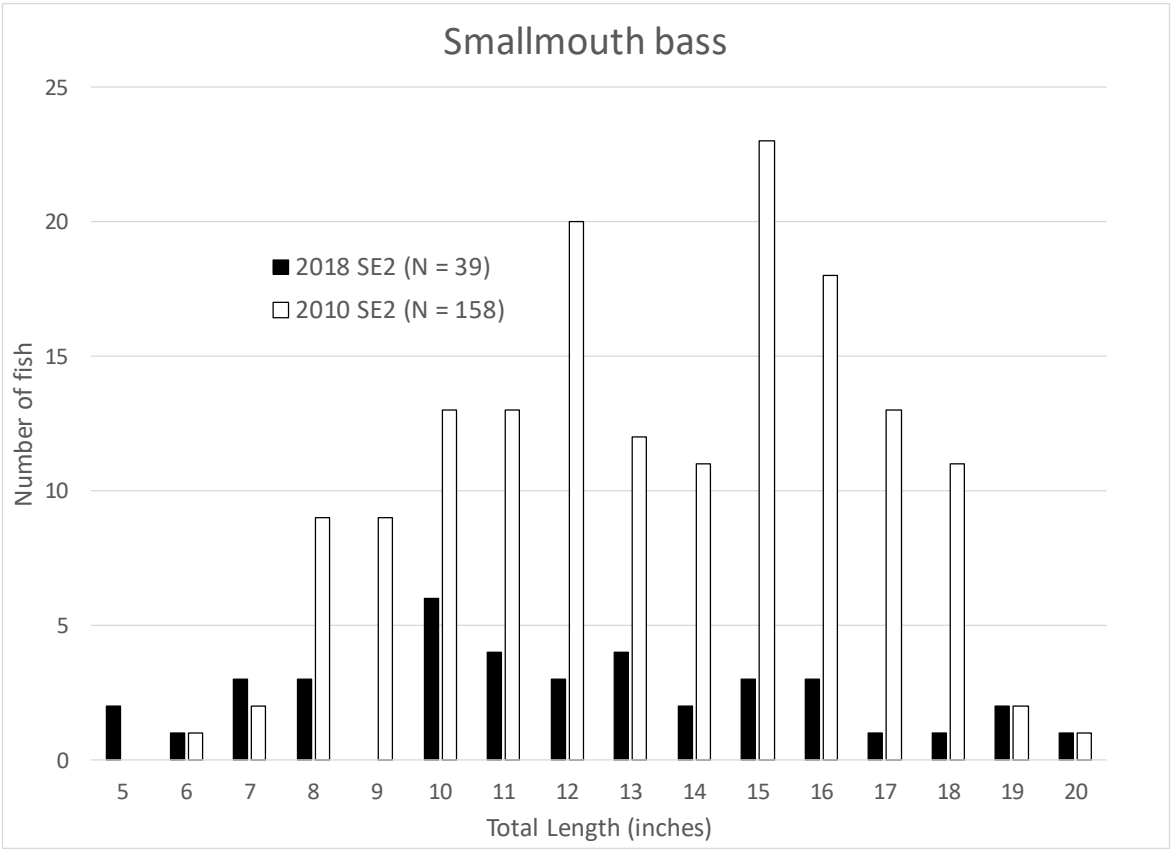

Figure 14. Smallmouth bass length frequency from 2010 and 2018 on High Falls Flowage; Marinette County, WI.

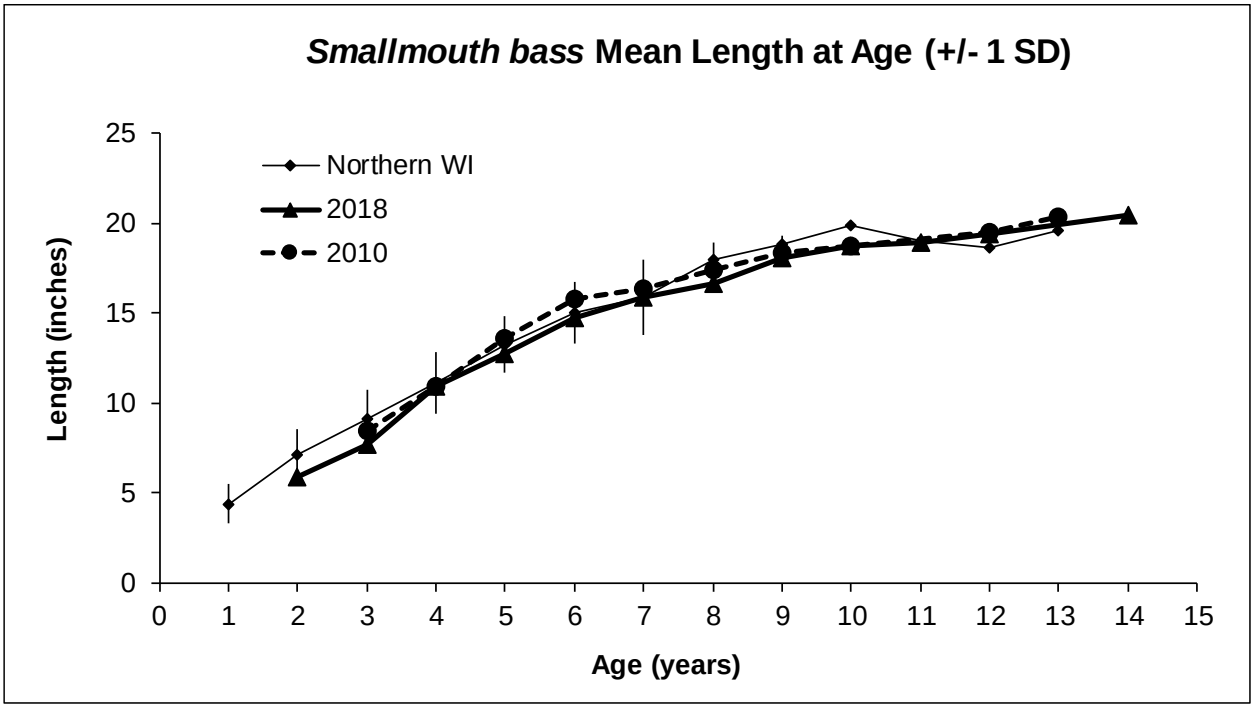

Figure 15. Smallmouth bass mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.

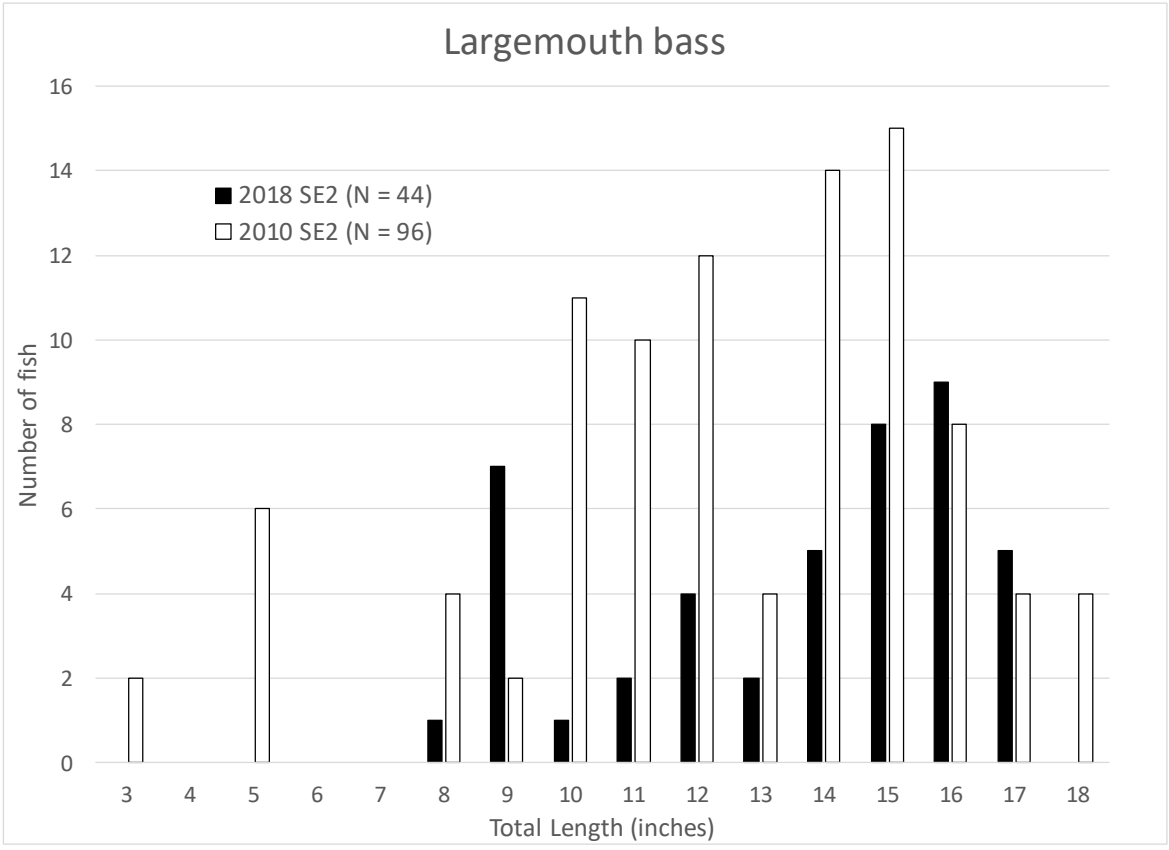

Figure 16. Largemouth bass length frequency from 2010 and 2018 on High Falls Flowage; Marinette County, WI.

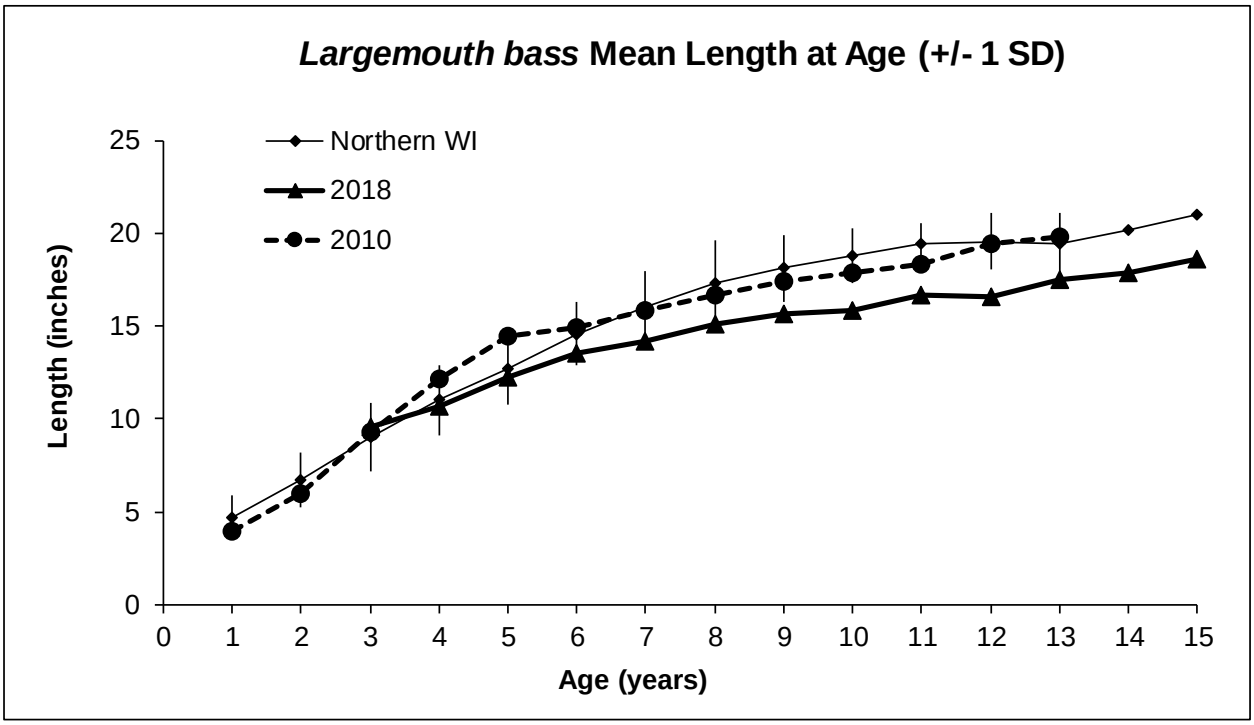

Figure 17. Largemouth bass mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.

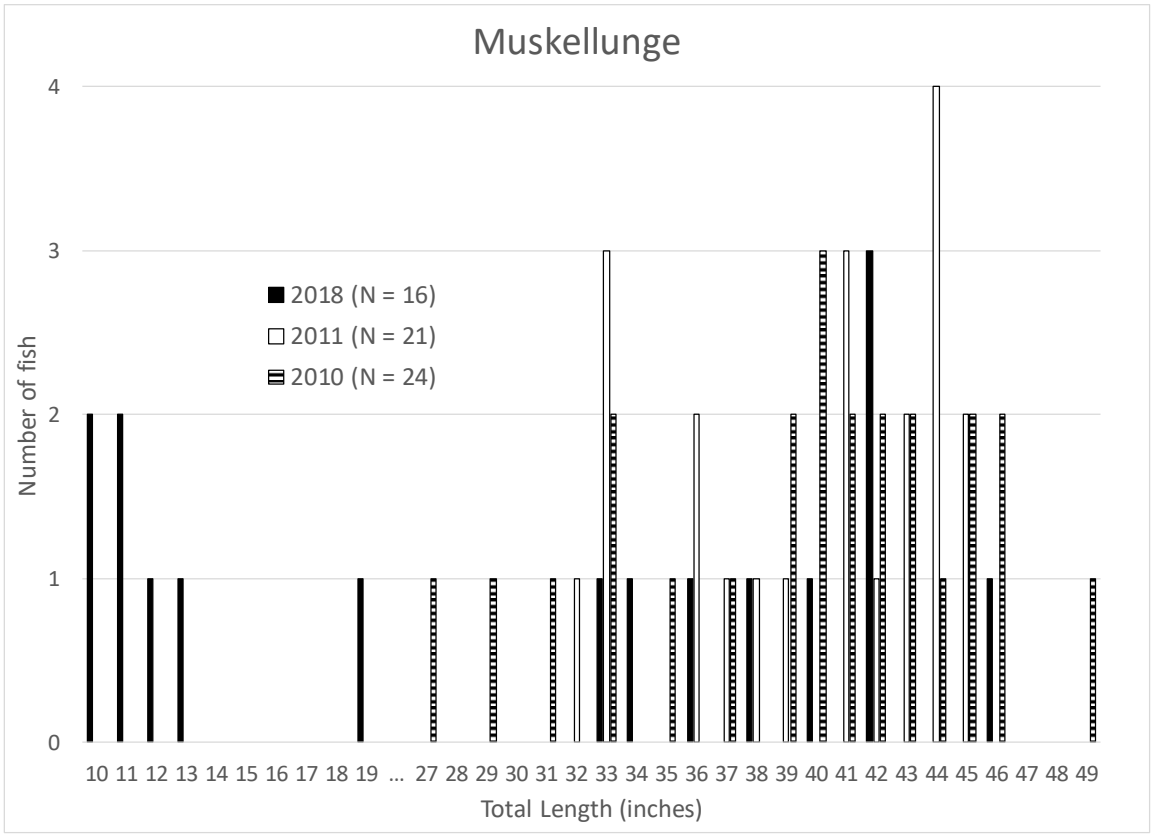

Figure 18. Muskellunge length frequency from 2010, 2011 and 2018 on High Falls Flowage; Marinette County, WI.

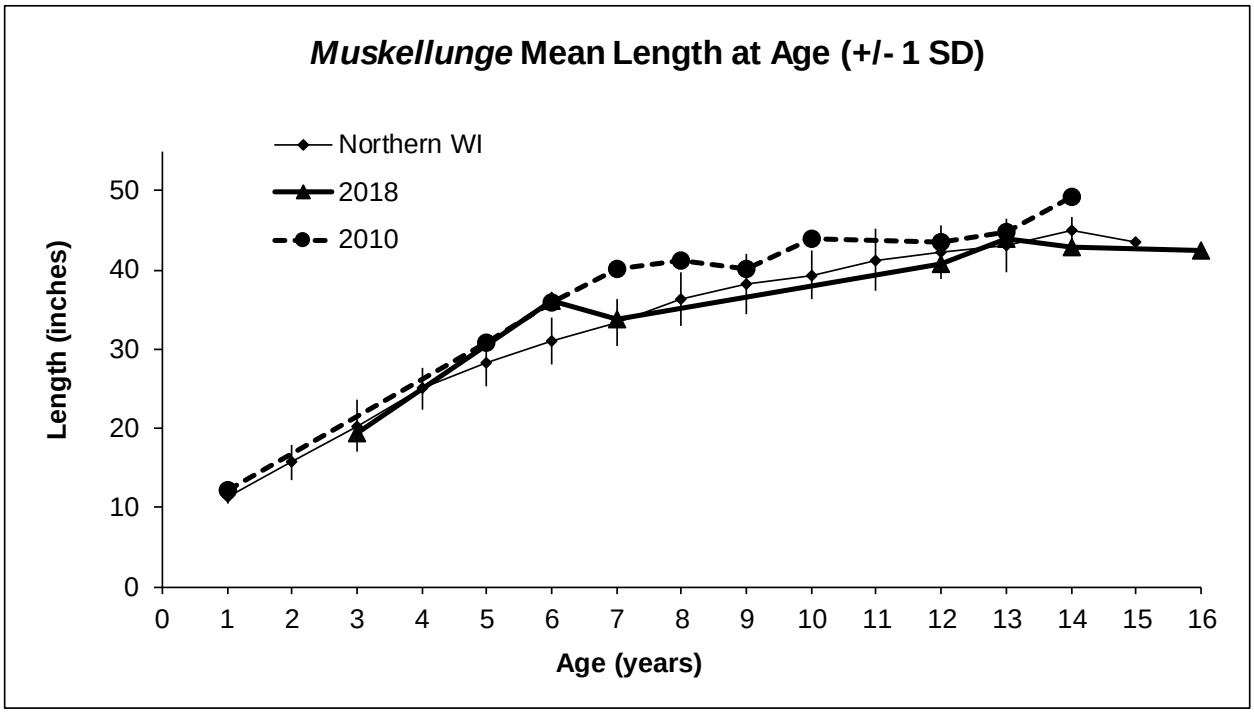

Figure 19. Muskellunge mean length at age (+/-1SD) High Falls Flowage; Marinette County, WI.